THE

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition

NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

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ELECTRIC LIGHTING COMPANY AND CONSUMER.

CERTAIN letters recently published in the columns of the *Times* disclose the existence of difficulties between a prominent Metropolitan lighting company and some of its customers. If we are to believe the statements there made by the various correspondents, it would appear that the particular company, "owing to a rapidly increasing demand for supply," has chosen to break its contracts with some of its old customers instead of its recent contracts, made prematurely, with the new ones. Other counts are added to the indictment. Thus it is alleged that whereas in some districts the light never fails, others are plunged in total darkness, while the devoted company is also unblushingly accused of pandering to consumers whose claims for breach of contract (*sic*) would be heaviest! The letter which contains the above accusations was written subsequently, and in answer to an explanation which was published by the secretary to the company (Mr. E. Cunliffe Owen) in the *Times* of December 7th. He there, at the request of his employers, took the trouble to explain that more than two years ago the Metropolitan Electric Supply Company, Limited, owing to a rapidly increasing demand upon their resources, commenced to erect a large generating works at Willesden. The non-delivery of iron prevented the completion of such works until a comparatively recent date, arrangements being made in the meanwhile for obtaining help from a neighbouring company—succour which failed to prove beneficial in the hour of need. Yet another excuse—and as it appears a most plausible one to those who know no better, is advanced on behalf of the supply company. With the help obtained by the partial working of the plant at Willesden, one of the engines having been completed, they would have been able to meet all reasonable demands, had it not been for the lack of Welsh steam coal, owing, it is stated, to the requirements of the Government for the South African transports.

Readers of the REVIEW, however, need no reminder of the numerous articles which have recently appeared in our columns to show that this excuse ought not to avail any company whose works had been planned on proper lines.

Does the *Times* correspondent gravely argue that it is the duty of a supply company to foresee such a catastrophe? Can they refuse (if, indeed, they have statutory powers in that behalf) to lay additional wires because some *force majeure* may intervene to prevent them from completing the plant wherewith to furnish an increased current?

"Every effort," says Mr. Owen, "has been made to obtain deliveries regardless of cost, but practically without success, and the coal at present being received renders it almost impossible to maintain a proper pressure of steam at times of greatest demand."

While we think that every allowance should be made to a

company, when beset with misfortunes which no human foresight can prevent, the fact that they are unable to run at full power owing to an alteration in the quality of the fuel at their disposal, should not be allowed to prejudice the consumer. As was pointed out in a recent issue of this journal, there is no reason why every lighting station should not have been equipped with furnaces designed so as to be capable of consuming the most bituminous of coal. It appears that the real difficulty with which the Metropolitan Electric Supply Company have had to contend, is the smoke which issued forth in such volumes that an order was made to compel them to alter their furnaces so that bituminous coal could be burnt without causing a nuisance. Doubtless public attention has been forcibly called to the matter within the last few months, owing to the formation of a society whose object it is to wage war against smoke; but it would be idle for any company to excuse themselves from meeting the demands of the consumers, by referring to the disastrous result of recent police court proceedings—proceedings, moreover, which if they have the effect of compelling the company to lay down smoke-consuming furnaces, may bring about economy of fuel in the long run.

The correspondent to whose complaints we have already alluded, states that several years ago the company obtained power, which was practically exclusive, to supply a certain district upon certain conditions, one of which was that it should supply electricity efficiently and continuously to all who required. Without having the company's provisional order before us, it is somewhat difficult to deal with the points which are raised against it. We may, however, safely assume that the provisional order was in the form in common use before the Electric Lighting (Clauses) Act, 1899, came into force. Although that Act has no application to London, its provisions embody the common form of nearly every provisional order. To traverse "Zetetes's" allegations *seriatim*, he implies, in the first place, that the company has no right to supply new customers before it had the means of supplying all. A reference to an article, entitled "The Liability of a Supply Company to Meet the Demands of Consumers," which was published in the ELECTRICAL REVIEW for December 8th, at p. 910, clearly shows that there is nothing in the usual form of provisional order to prevent a company from refusing to supply electricity upon the ground that its plant is not sufficiently powerful. This should be qualified by saying that there may be special terms inserted in the provisional order or special Act defining the amount of electricity which the company must be prepared to furnish to all comers. The statement that the company endeavours to show favouritism among its customers is a bare statement, and nothing more. We venture to think that no company would risk the consequences of such a course of conduct, especially when we bear in mind that an exclusive monopoly of the electrical supply in a district is no longer possible. With regard to the liability for default in making a supply, no penalty is inflicted if the Court are of opinion that the default was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of a supply. [See Section 28 of Form of Provisional Order, Laws of Electric Lighting, by Shiress Will, Q.C. (1898), p. 159.]

The Standardisation of Copper Constants.

THE report of the Committee on Copper Conductors, which we reproduce elsewhere, will, we trust, put an end to the confusion which has reigned up to the present with regard to the so-called "Matthiessen's standard." The report is not quite correct in stating that "everyone" assumed that Matthiessen had settled the constants of copper in his invaluable researches; the question has often been raised, and we believe that Prof. Ayrton, who is a member of the Committee, thoroughly sifted the matter some years ago and came to the conclusion that "Matthiessen's standard" was a myth! Now, however, thanks in great measure to the efforts of Mr. A. H. Howard, who was largely instrumental in the formation of the Committee, of which he is honorary secretary, the difficulty is in a fair way of being removed. We may recall the fact that the Institution of Electrical Engineers, in its "Wiring Rules" of 1897, fought shy of the question, and fixed its own standard of conductivity, which, curiously enough, is almost always expressed in terms of *resistance*, and should be called resistivity. This standard was stated as follows:—"The resistance of a copper wire, weighing 100 grains, 100 inches long, should be 0·1516 ohm at 60° F." Comparing this with the present report, we find that the Institution's standard is almost exactly the mean between the values given by the Committee for hard drawn and annealed copper; the former, therefore, was more favourable to the cable manufacturers. The temperature coefficient which has been adopted will meet, we think, with general approval. It is well known to those who have had occasion to go into the matter that the value commonly accepted is far too low, and that the purer the copper the higher is the coefficient. It must be borne in mind that not even the value named by the Committee will be quite correct for all samples of pure copper. We sincerely trust that in their revised tables of resistance, weight, length, &c., the manufacturers of cables will refrain from presenting an absurd array of figures, extending as some do to seven significant figures! Seeing that one could not hope to find the actual measured values identical with the tabulated values even to the fourth figure (the Committee allow for a variation of *2 per cent.!*), what is the use of such fictitious "accuracy"? We are glad to note an improvement in this respect in some recently issued tables.

The Secor Kerosene Motor.—In the *American Machinist*, a paper of sound mechanical ideas and the best exponent of American shop practice, we find a description of a new oil engine. *Apropos* of this and of other motors utilising stored energy, the following figures are given, showing the number of foot-pounds of energy which can be stored by different media:—

Source of energy.	Foot-pounds stored per pound of medium.
Good storage battery	15,000
Liquid air from 2,000 lbs. pressure down to atmosphere	139,100
Coal of 14,600 B.T.U. in steam plant of 12½ per cent. overall efficiency	1,408,000
Kerosene of 20,700 B.T.U. in oil engine of 35 per cent. overall efficiency	5,593,000

This is a telling commentary on the limitations of storage batteries and on the nonsense claimed for compressed air. The pound of oil is equal to 400 lbs. of storage battery. In the Secor engine the kerosene is fed by a ball valve into a small tank, whence it falls by gravity through the admission cock into the air admission pipe; the air and oil admission valves are controlled by the governor, equal and uniform mixture being aimed at. Governing is thus effected by reduced charges, and the initial compression is less with feeble charges, which are wire-drawn into the cylinder. Not an economical system, perhaps, but one which it seems desirable often to adopt even at the price of reduced economy. The engine illustrated in our contemporary is of vertical type with electric ignition from a six-cell battery and coil. The speed is 350 per minute, the cylinders are water jacketed, and the cost of power is said to be ¼d. per H.P.-hour. The valves are driven by cam gear with friction roller in a double path cam, and the governor is of fly-wheel type in a rim pulley. The crank cheeks have fan tails and the piston is of trunk form. The Otto cycle is employed.

THE UTILISATION OF BLAST FURNACE GASES IN THE GENERATION OF ELECTRICITY.

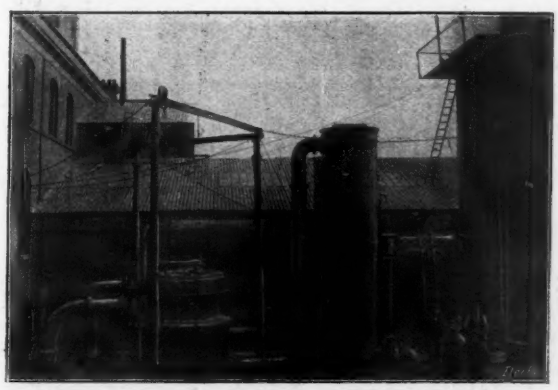
(*Concluded from page* 987.)

The Application to Blowing Engines.—The chief power required in connection with the blast furnace is that necessary for actuating the blast furnace blowing engines, and the substitution of the economical gas-power for the far from efficient steam-power obtained by burning blast furnace gas in the flues of steam boilers, will, of course, have the greatest attraction for blast furnace managers.

Blowing engines driven by blast furnace gas are being made in this country, Belgium, and Germany, and will be working before many months have passed, when the perfection of the greatest advance in the economical production of pig-iron of the century will have been made.

So as to avoid the intervention of gearing, the blowing piston is made to travel faster than has usually been the practice with steam, gas engines being found to work best at speeds varying from 80 to 200 revolutions per minute. The air admission and discharge valves have therefore to be designed to admit of this increased speed.

In the case of gas engines working upon town gas, there is always an available supply of gas in the large gas holders; but in using blast furnace gas there is no necessity for this expensive adjunct. The very large volumes of gas produced by the blast furnaces are not stored in gasometers, but, by means of a fan arranged for exhausting and delivering the gas, a regular supply of gas is obtained in some excess of the requirements of the gas engine at any time, the excess of gas being allowed to pass back to the exhaust side of the fan.



Physical Purifiers for Cleaning Blast Furnace Gas.

Advisable Precautions.—To obtain the highest efficiency when using gas engines driven by blast furnace gas for the generation of electrical current, it is an advantage to arrange the units of power to suit the required loads, instead of allowing the engine at times to be running at half power.

By grouping two or four cylinders around one main shaft the ignitions can be regulated to give one or two impulses each revolution, in which case the fly-wheel does not require to be so heavy in proportion to the power as when a single cylinder is employed, and the use of multiple cylinders permits of the direct connection of the dynamo to the gas engine shaft.

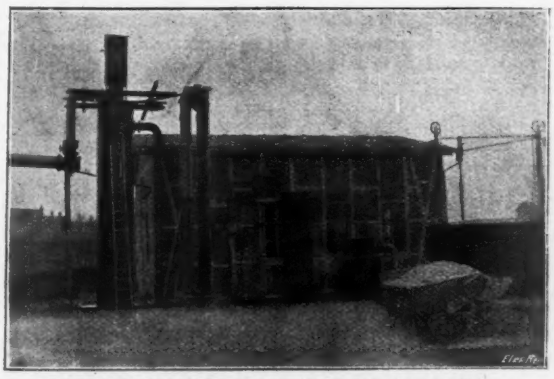
Blast furnace gas, when used in the cylinders of internal combustion engines, has a considerable advantage over town's gas. Engines designed to use town's gas are generally governed upon the hit-or-miss principle, in which case, on the speed being accelerated, the governor cuts out the charge of gas and no explosion takes place, but with furnace gas the admission of the gas can be graduated so that an explosion of less violence can take place, thus making the running of the engine more regular.

Power of Blast Furnace Gas in Gas Engine Cylinders.—Mean pressures in the cylinder with furnace gas can be obtained as desired from 38 lbs. per square inch up to 60 and 70 lbs. per square inch, and this without any risk of a miss in the ignition, the higher pressures, of course, being obtained where the gas is of superior thermal quality. (See diagrams on page 992.)

Electrical power generation has been effected by the use of blast furnace gases from both coal-fed and coke-fed furnaces with very considerable success.

Scotland's pioneer plant at the Wishaw Works of the Glasgow Iron and Steel Company, Limited, where splint coal is employed in the blast furnaces, though not very large, has been working successfully for about four years, see p. 992. The gas in this case is previously treated for bye-products, afterwards being treated for the removal of the dust.

The engine develops a little over 20 I H P, and drives a

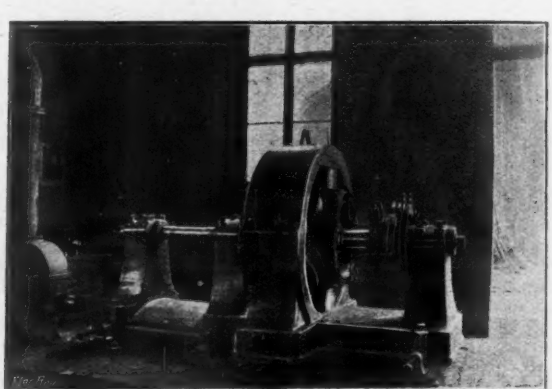


Calcic Carbide Installation.—Gas Treatment Plant.

dynamo which supplies current for both arc and incandescent lamps, thus instead of, as in the olden times, the gas being allowed to burn at the mouth of the furnace and in a very ineffectual manner lighting up the surrounding district, it is now scientifically applied for economically lighting such localities as require illuminating.

The gases issuing from coke-fed furnaces are the poorest in thermal value, and therefore the successful application of this quality of gas to the generation of electricity is of especial interest.

In the Westphalian iron district in Germany, a Thwaite-Gardner installation was put down for treating the gases from coke-fed furnaces, with the object of applying the power to the production of electrical energy for the manufacture of calcic carbide. The success which has resulted from the application of acetylene gas to illuminating purposes has caused a considerable demand for calcic carbide, and as this can only be economically produced by electric current generated in the least costly manner, water-power had the monopoly until the Thwaite-Gardner patents admitted the utilisation of blast furnace gas to enter the field as a competitor. The comparison of cost of electric energy by steam-power and water-power has been dealt with on more than one occasion, but besides the low cost of electric current when produced by blast furnace gas, there are the many advantages

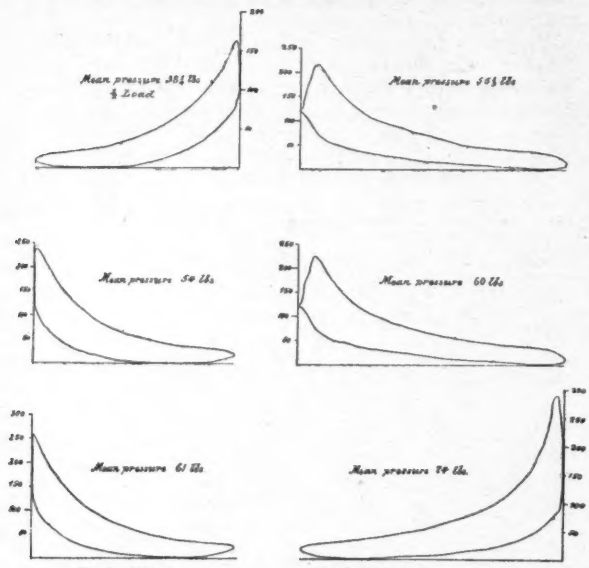


Calcic Carbide Installation.—Alternator and Fan.

of associating the manufacture of calcic carbide with that of pig-iron making.

In 1898 the plant was started. The gas had a thermal

value of about 112 British thermal units, and was applied to a gas engine capable of developing 150 I.H P. The engine was of the twin cylinder (side by side) type, and was governed



Engine 200 I.H P. Gas 105 B.Th.U. per cb. ft. Engine 150 I.H.P. Gas 120 B.Th.U. per cb. ft.

Diagrams with Blast Furnace Gas, Using Coke Fuel.

on the hit-or-miss principle. The alternator was belt driven, and supplied the electric current for a calcic carbide furnace. The engine is readily started by a small gas engine by means of suitable gearing.

In the Lancashire district, where the thermal value of the gas was only about 100 British thermal units, an engine of larger size was applied.

The gases were about as low in thermal value as can result from the manufacture of pig iron by coke. In this case the power was required to produce electrical energy for electric lighting and power purposes.

During five days' *continuous working* test it was found that the engine developed a maximum of 180 I.H.P. when carrying about three-quarter load, with a consumption of 132 cubic feet of gas per I.H P.-hour, the engine, therefore, giving an efficiency on the thermo-dynamic production of 19 per cent., and on a production of 170,000 cubic feet of gas per ton of coke charged into the blast furnace for *pig iron smelting*, the actual practical efficiency amounts to 11·25 per cent., which is certainly a remarkable result, considering that under the same conditions good steam engine practice only returns to about 5 per cent., and gas engines working with producer gas give 15 per cent. on fuel burned *only* for the production of this gas.

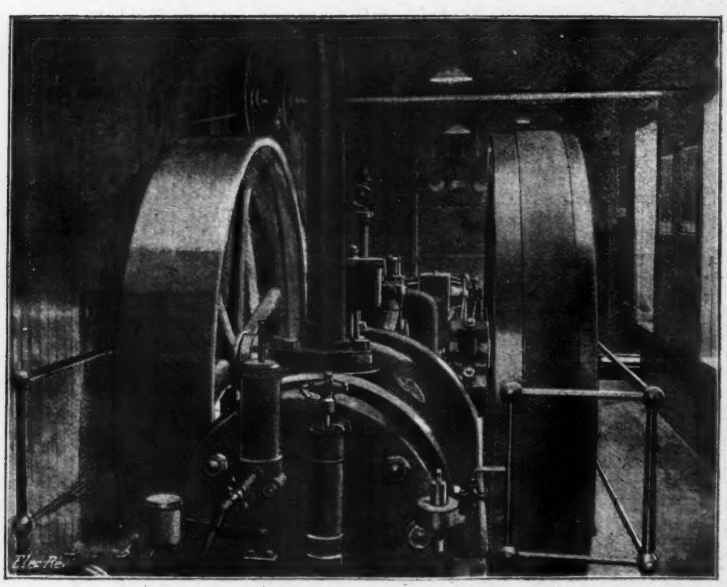
The same quality of gas, when employed in boiler flues for raising steam, is computed to require at least 700 cubic feet per I.H P., or over five times as much as when exploded in the cylinders of a gas engine.

The efficiency of the engine and dynamo during the above trial was found to be 71½ per cent.

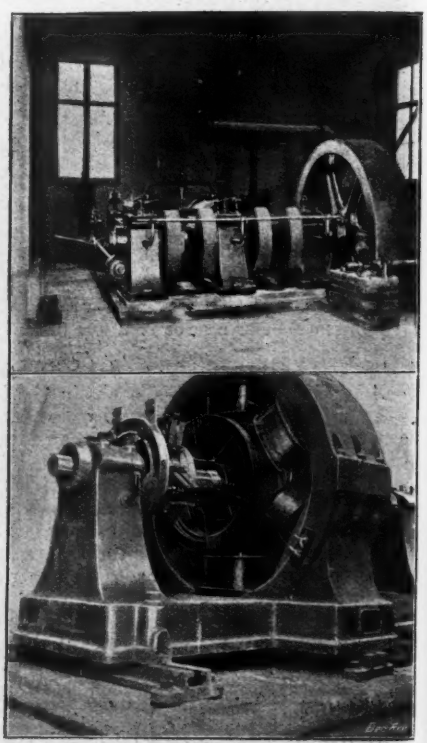
Financial Considerations.—It is not very easy to give an estimate of the money value of blast furnace gas in comparison with other fuels, as at most blast furnaces there could be a considerable sized installation running continuously, using only gas which was prevented from going to waste, in which case the fuel cost of the installation would be *nil*, while, of course, its value would be represented by the cost of fuel which would otherwise have been required.

The Rapid Advancement of the New System. — Rapid advances in the application of blast furnace gas to power purposes are being made in this country and on the Continent, and the driving of iron and steel works' machinery by electric motors is one of the important incentives to managers to adopt this method for the cheap production of electric power, for at most ranges of blast furnaces there is little difficulty in arranging for a sufficient supply of gas being available for the production of all the electrical energy necessary for driving the machinery of adjoining steel works, as far as the application of electric motors has been possible up to the present.

Nothing has been said so far as to the advantage of doing away with the very inefficient steam boilers, with their low pressure steam, and liability to explosion, not to mention the difficulties so frequently incurred in keeping up even the low pressure steam through bad draught, &c., but this will be obvious to all professional men.



Pioneer Plant at Wishaw.



Calcic Carbide Installation.—Gas Engine and Alternator.

Greenock.—At a private meeting of the Police Board last week, it was decided that the Greenock and Port Glasgow Tramways Company, Mr. W. M. Murphy, Messrs. Dick, Kerr & Co., the British Schuckert Company, the British Thomson-Houston Company, Limited, the Drake & Gorham Electric Traction Company, Limited, and the English Industrials, Limited, these being the firms which had applied for copies of the heads of conditions—should be invited to offer for the leasing of the lines on their own conditions.

SOME NOTES ON ROTARY CONVERTERS, WITH SPECIAL REFERENCE TO THE EXTENSION PLANT OF THE CHICAGO EDISON COMPANY.

By A. C. EBORALL.

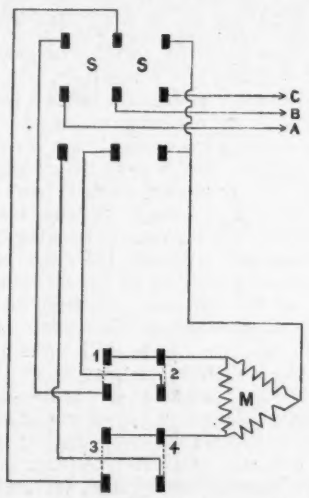
(*Concluded from page* 953.)

Fig. 3 illustrates the external appearance of one of the induction regulators, whose duty is to regulate the pressure

Fig. 3.

of the feeders. These regulators have no sliding contacts, but are adjusted by moving an iron core, which varies the inductive effect of a shunt winding upon a series coil. This core may be moved by hand, but, for convenience in operating from a distance, the core of each regulator is moved by means of a small three-phase motor geared to it by worm gearing, and mounted upon the top of the regulator. The three-phase motor is controlled from the main switchboard in the following manner:—

A small triple-pole throw-over switch is mounted on the switchboard for each regulator, connections being taken from it in the manner shown in fig. 4, from which it will be seen that



s s, Double-throw motor control switch on switchboard; M, Small induction motor geared to shaft of I.R.T. regulator; 1, 2, 3, 4, Limit switches open automatically at end of travel; A, B, C. To A.C. side of generator.

Fig. 4.

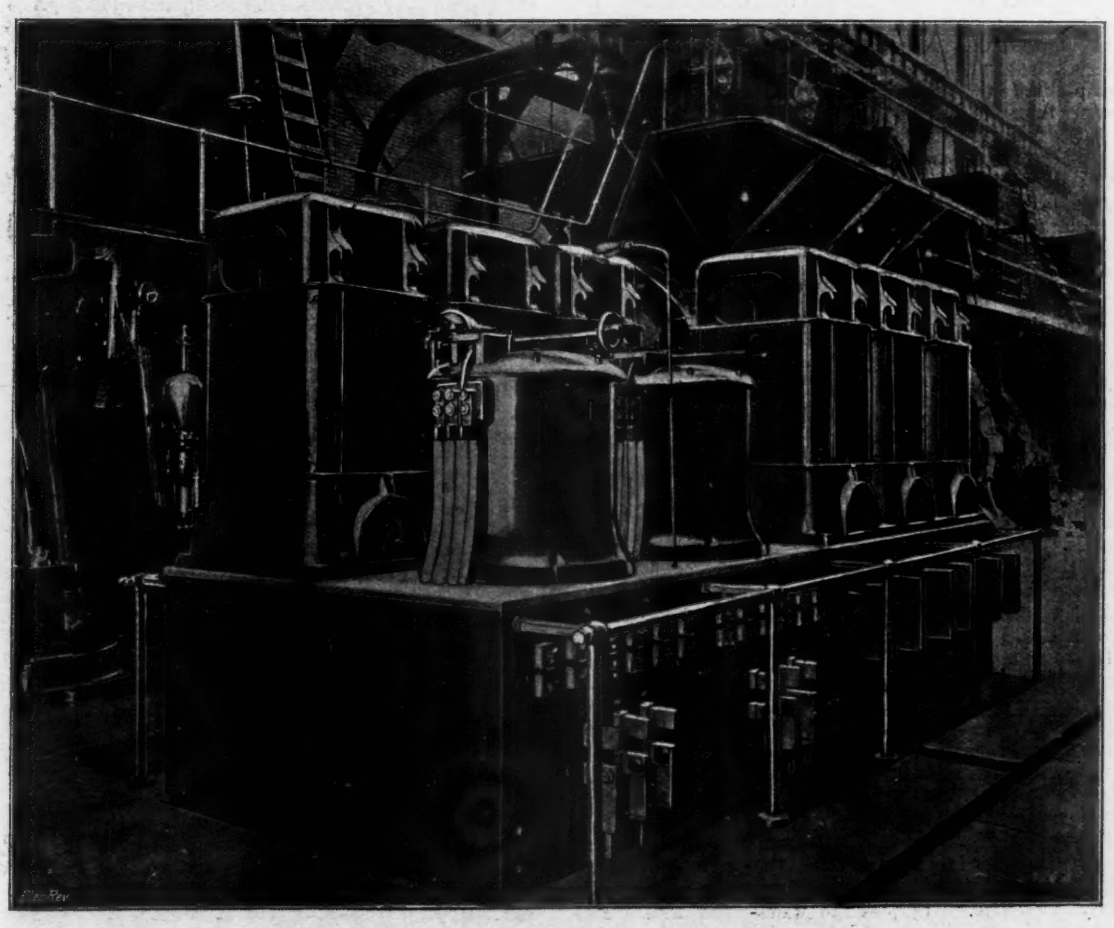


Fig. 5.

if the switch is up, the motor will run in one direction, thus raising the pressure by moving the core out, while if the switch is thrown down, the motor will run in the reverse direction, and thus lower the pressure. Referring to the figure, the three-phase current enters through the leads A, B, C, to the hinges of the throw-over switch. One lead, C, goes right through to the motor whether the switch is up or down. Leads A and B go through other switches located on the regulator, and numbered, respectively, 1, 2, 3, and 4 in the diagram. These are "limit" switches, which prevent the small motor from moving the core too far, in case the switchboard attendant tries to raise or lower the pressure beyond the capabilities of the regulator. In case he leaves his switch in the upper position, switches 1 and 3 are opened automatically when the regulator reaches its highest boosting position, thus stopping the motor, but it is obvious that this does not cut it out of circuit when the attendant throws his switch over to the downward position, when the circuit of leads A and B is made through switches 2 and 4. These, however, open when the regulator is lowering the pressure by its maximum amount to prevent the motor running too far in that direction. The extent of the arc through which the movable part of the induction regulator may be turned is thus limited automatically. The total range of each regulator is 15 per cent. of the initial pressure—that is, it will regulate the pressure 7½ per cent. up or down.

Fig. 5 shows the arrangement of the step-up transformers and induction regulators in the power station. The six transformers and four regulators of the four generators constituting the two sets stand on a platform in the middle of the floor space between the two sets, and are all air-cooled. Under the platform, and enclosed by marble sides, is a large air chamber in which all the electrical connections between transformers, regulators, and fuse panels are made. Air is forced into this chamber by a blower driven by a direct-current motor, whose speed is controlled by a speed regulator, so that the proper volume and pressure of air may be maintained in the chamber. The transformers and regulators are provided with dampers, which regulate the amount of air passing through them individually, and may be adjusted according to the division of the load between them. On the sides of the chamber, mounted directly on the marble, are the high pressure fuse blocks already referred to, and the low pressure fuses and switches, the former being away from, and the latter facing, the units to which they belong. There are thus no leads to the switchboard panels carrying heavy currents; all such leads run directly from the generators to the transformer stand, and are very short. Moreover, there are no high pressure leads on the switchboard, as the switch gear is at a distance from it, and operated pneumatically.

At the receiving end of the line, in the up-town sub-station, are the necessary apparatus and appliances for reducing the pressure, changing the current to direct, and distributing it over the feeders of the three-wire network. This installation in general consists of the following:—

A high tension switchboard, with switches and fuses for each set of transformers; three sets of three 150-KW. air-cooled transformers; five induction regulators; two 100-KW. 125-volt rotary converters; two 200-KW. 125-volt rotary converters; one 250-KW. 250-volt rotary converter; with the necessary low-tension switchboard for regulating and controlling both the polyphase and direct current sides of the rotaries.

All the details of the double-current plant and system described above have evidently been thoroughly worked out, and reflect considerable credit upon the engineers of the General Electric Company, of America, who carried out the work.

Before concluding these notes, the writer would like to cite another and recent case where rotary converters are to be employed in a special manner, this time by his own firm. The tramway installation laid out by Messrs. Electricité and Hydraulique, Limited, of Charleroi, for the town of Sofia, is to have a generating station driven by water-power at a considerable distance from the town. Here high pressure three-phase currents will be generated, and sent over aerial lines to a sub-station in the town. In this station, the high pressure current will be transformed into direct current by means of stationary transformers and over-compounded rotary converters. But, as the water-power available is very variable, and might, under certain circumstances, fail altogether, these rotaries will be direct coupled to vertical engines, so that, if necessary at any time, the rotaries can be used as ordinary railway generators to supply the tramway system wholly or partly with current. Of course, suitable clutches will be arranged between the engines and the rotaries occasionally to be driven from them.

THE SCIENTIFIC PRINCIPLES OF PUBLIC LIGHTING BY ARC LAMPS.

By F. W. CARTER, M.A.

PUBLIC lighting by arc lamps has so long passed its experimental stages that it may be questioned whether any further study of its underlying principles can be fruitful at this date, and whether anyone wishing to plan an installation need do more than look up particulars of similar installations already in existence. But though hard bought experience will remain the chief guide in this matter, for it alone will take account of all the circumstances of the case, nevertheless a study of underlying principles may suggest modifications tending to the improvement of the system under consideration.

Whilst we are able to compare our artificial lighting with daylight, we are forced to confess that our best efforts are in general so far from ideal that it remains a debatable question, and a matter of opinion, what is the best distribution of light for any particular circumstances; some would prefer the illumination to be as uniform as possible, whilst others would advocate having patches of very bright light, even if other parts have in consequence to be left in comparative darkness. Another particular in which artificial light must fall short of daylight, at any rate out of doors, arises from the fact that the light proceeds from discrete sources, so that whereas in daylight an object will be illuminated in almost any position, by artifical light its illumination depends on how it is turned towards the sources. This has given rise to some differences as to how we should judge of the value of a system of lights, whether by their illumination of horizontal objects, of vertical objects, or of objects otherwise inclined. Whilst it is necessary to be able to see the roadway or ground as plainly as possible, it is also useful to be capable of easily distinguishing persons and objects standing vertically on the ground, so that a light that is too high up may illuminate the ground well, but be unsatisfactory on account of its nearly vertical rays only just grazing vertical objects. Again, one wishing to examine anything by artificial light naturally turns the object so that it shall be as highly illuminated as possible, so that, from this point of view, the maximum illumination is important. Since the horizontal plane is symmetrical with respect to the axis of the lamps, the illumination thereof is easy to deal with, the effects of the several lamps being additive. With but one lamp there is no difficulty in finding the illumination of the vertical plane turned towards it, as well as that of the plane inclined so as to have as great an illumination as possible. These, perhaps, include the most important cases, as one who has something to examine, or who wishes to stay to converse with another, or whatnot, naturally does so in the neighbourhood of a lamp where the effects of distant lamps are unimportant.

In street lighting the illumination will be increased somewhat by the reflections from neighbouring houses and walls, and this effect may be considerable in narrow streets and other places where the lamps must be on the sidewalks.

The use of such powerful sources of light as the electric arc gives rise to a physiological effect that may be noticed here. This is the partial blindness experienced when the eye catches sight of a very bright light. For ordinary street lighting, for instance, arc lamps with globes on are far more satisfactory than naked arcs, although the globes usually absorb from 30 to 40 per cent. of the light of the arc, for the naked arc so dazzles the eye that the illumination seems much less than it is. For this reason the naked arc can only be tolerated for lighting open spaces, such as goods yards and market places, or for very wide streets, where the lamp can, without detriment, be put at a much greater distance from the ground than is usual in ordinary street lighting.

It will be seen, then, that many considerations enter into

this subject, and we must be prepared to find that the results of applying some scientific method to the solution of the problem of finding a system of lights to satisfy specified conditions, require considerable modification to make them practically useful.

Before proceeding further with the subject, let us define some of the terms which we shall use. The unit of intensity is the "candle-power," or the intensity of the light given out in a horizontal direction by a certain standard sperm candle, which does not differ very much from an ordinary paraffin or tallow candle. The standard candle will not give out light of the same intensity in every direction, but let us suppose we have a unit source whose intensity of emission is 1 C.P. in every direction; then the intensity of *any* source in any particular direction is the number of these unit sources that we must put in the place of the light considered, in order to have the same luminous effect as the light in question has in that direction. It would seem almost unnecessary to give this definition, but there appears to be an idea in some quarters that the intensity of a

Fig. 1.

source of light has something to do with the law of inverse squares—an impression arising from the usual method of measuring it. The definition strictly applies only to point sources, but as we shall consider the luminous effect always at distances which are great compared with the size of the source, we need not complicate it with generality. It should be noted that, in treating of an arc with a globe on, the combination of the arc and globe form the source, and not the arc only. The intensity of a source will generally be different in different directions. If from the source of light we draw lines in every direction, each of length numerically equal to the intensity of the light in its direction, the surface on which the ends of these lines lie is called the "photometric surface" of the source, and the mean length of the lines, supposing them equally distributed, is called the "mean spherical candle-power" of the source. If the source is symmetrical about an axis, as is usually the case with arc lamps, the photometric surface is one of revolution, and all sections by planes through the axis are identical; any such section is called the "photometric curve" of the source. The photometric curve then, of which we shall hereafter make considerable use, is a curve drawn in any plane containing the axis of the lamp, and having its radius vector in any direction numerically equal to the intensity of the light in that direction. The illumination of a surface at any point is proportional to the quantity of light falling on unit area at the point. It is measured in terms of the "candle-foot," which is the illumination of a surface facing a standard candle, and at a distance of 1 foot from it. At a distance of 2 feet, the same amount of light, assuming that it comes from a point, has to cover four times the area, so that the illumination is $\frac{1}{4}$, at 3 feet it is $\frac{1}{9}$, and so on. This is the law of inverse squares. The illumination, of course, varies directly as the intensity of the light. Hence, if the intensity in a particular direction is I candle-power, the illumination of a surface situated in that direction, distant r feet from the source, and facing it, is $\frac{I}{r^2}$ candle-feet. If the surface does not face the source, we have also to multiply by the cosine of the angle through which it is turned from its position facing the source, or, what is the same thing, the angle between the direction in which the source lies, and the normal to the surface. This can be seen as follows:—Let S (fig. 1) be the source, A C a section of the surface on which the light falls, A B a section of a surface S and intercepting the same amount of light as A C; let the angle CAB = α = BCN. Then the area AB = the area A C × cos α.

Since the same amount of light falls on A C as on A B, the amount per unit area on A C is to that on A B inversely as the area A C to the area A B, that is as cos α is to 1. Thus the illumination of A C = the illumination of A B × cos α.

$$= \frac{I}{r^2} \cos \alpha, \text{ candle-feet.}$$

If the source of light is not a point, the law of inverse squares is not true, but in the cases we shall consider the distance from the source will always be great compared with the linear dimensions of the sources, and we shall make no great error in assuming that the source is a point.

We are now in a position to see what these quantities reduce to in the particular cases we are considering.

Let A (fig. 2) be an arc lamp, AB, the vertical, being its

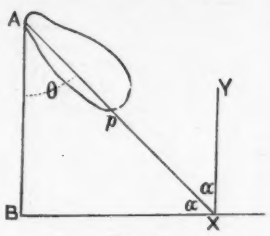


Fig. 2.

axis. Let A P Q be the photometric curve of the lamp, the vectorial angle (θ) being measured from the vertical. Let B X be a horizontal, and XY a vertical. The illumination of a plane at X turned towards the arc; *i.e.*, the total illumination at X, is $\frac{I}{r^2}$ candle-feet, where A P = I candle-power and A X = r feet, the illumination of the horizontal plane at X is $\frac{I}{r^2} \cos \alpha$ or $\frac{I}{r^2} \cos \theta$ candle-feet, and that of the vertical plane facing the lamp-post is $\frac{I}{r^2} \cos \alpha'$ or $\frac{I}{r^2} \sin \theta$ candle-feet.

Now A B = $r \cos \theta$, whence

$$r = \frac{A B}{\cos \theta}$$

Thus the total illumination $= \frac{I}{r^2} = \frac{I \cos^2 \theta}{A B^2}$ candle-feet.

The horizontal illumination $= \frac{I}{r^2} \cos \theta = \frac{I \cos^3 \theta}{A B^2}$ candle-feet.

The vertical illumination $= \frac{I}{r^2} \sin \theta = \frac{I \cos^2 \theta \sin \theta}{A B^2}$ candle-feet.

When X is on the ground, A B is the height of the lamp, which we will call h feet. If X is at a height h' feet above the ground, A B = $h - h'$ feet. Thus if the height of the arc above X (*i.e.*, $h - h'$) is given, the most convenient expressions for the total, the horizontal, and the vertical illuminations are respectively—

$$\frac{I \cos^2 \theta}{(h-h')^2}, \quad \frac{I \cos^3 \theta}{(h-h')^2} \text{ and } \frac{I \cos^2 \theta \sin \theta}{(h-h')^2} \text{ candle-feet,}$$

since all are expressed in terms of one variable θ. We shall perhaps best meet the demands of utility if we consider the horizontal illumination at the ground ($h' = 0$), and the total and vertical illuminations at a height of 4 or 5 feet above the ground ($h' = 4$ or 5).

(*To be continued.*)

[Erratum.—The angle α^1 (BXA) is marked α in figure.—Eds. Elec. Rev.]

Northern Society of Electrical Engineers.—On Tuesday last, 19th inst., at Manchester, Mr. Ferranti, the president of the above Society introduced for discussion the subject of the difficulties encountered in "The Use of Multiphase Plant in Conjunction with Continuous Current Systems of Supply."

SPEEDS AND STANDARD PERIODICITIES.

By E. KILBURN SCOTT.

In March last the Uniformity Committee of the Institution of Electrical Engineers published its report on the adoption of a standard of periodicity in alternating current working. The Committee was unanimous in recommending 50 periods per second for all ordinary work, 25 periods per second for power transmission on a large scale, and 100 periods for exceptional cases of house-to-house transformer supply.

Total number of poles of alternator or motor.	Periodicity per second.	Revolutions per minute of alternator or synchronous motor.	Revolutions per minute of induction motor with 7½ % slip.	5 % slip.	2½ % slip.
4	25	750	694	712	731
	50	1,500	1,388	1,425	1,462
	100	3,000	2,776	2,850	2,925
6	25	500	462	475	487
	50	1,000	925	950	975
	100	2,000	1,850	1,900	1,950
8	25	375	347	356	365
	50	750	694	712	731
	100	1,500	1,388	1,425	1,462
10	25	300	277·5	285	292
	50	600	555	570	585
	100	1,200	1,110	1,140	1,170
12	25	250	231	237	243
	50	500	462	475	487
	100	1,000	924	950	974
14	25	215	199	204	209
	50	430	398	408	419
	100	860	796	816	838
16	25	187	173	178	182
	50	375	347	356	365
	100	750	694	712	731
18	25	166	153	157	162
	50	332	307	315	324
	100	664	614	630	648
20	25	150	138	142	146
	50	300	277	285	292
	100	600	555	570	585
22	25	136	125	129	132
	50	272	251	258	265
	100	544	502	516	530
24	25	125	115	118	121
	50	250	231	237	243
	100	500	462	474	486
26	25	115	106	109	112
	50	231	213	219	225
	100	462	426	436	450
28	25	107	99	102	104
	50	215	198	204	209
	100	430	396	408	418
30	25	100	92	95	97
	50	200	185	190	195
	100	400	370	380	390
32	25	94	87	89	91
	50	188	175	178	183
	100	376	350	356	366
34	25	88	81	83	85
	50	176	163	167	171
	100	352	326	334	342
36	25	83	77	78	81
	50	166	153	157	162
	100	332	306	314	324
38	25	79	73	75	77
	50	158	147	150	154
	100	316	294	300	308
40	25	75	69	71	73
	50	150	139	142	146
	100	300	278	284	292
42	25	71	65	68	69
	50	143	131	136	139
	100	286	262	272	278
44	25	68	63	65	66
	50	136	125	129	132
	100	272	252	258	265
46	25	65	60	62	63
	50	131	120	124	127
	100	262	242	248	255
48	25	62	57	59	61
	50	125	115	119	122
	100	250	231	238	244
50	25	60	55	57	58
	50	120	111	114	117
	100	240	222	228	234
52	25	57	53	54	55
	50	115	106	109	112
	100	230	212	218	224

There are some who think it would have been wiser to have adopted American practice of 60 and 30 periods per second, but, generally speaking, electrical manufacturers have readily fallen in with the suggestions of the Institution Committee.

There is one point, however, which makes the adoption of standard frequencies somewhat awkward, and that is the speeds of prime movers. Practically all generators are nowadays coupled direct either to turbines or Pelton wheels, or else to steam or gas engines. The speed of the turbine or Pelton wheel is governed by the height of the fall, whilst the speed of an engine appears to be mainly a matter of chance. In this country we have to deal almost entirely with engines, but so far, not a single engine firm has adopted a line of speeds which fit in with the suggested standard periodicities.

Take Messrs. Willans & Robinson for example, their standard engine speeds are as follows:—

2 F's 3 F's	470 revs.	2 Q 3 Q	340 revs.
2 G's 3 G's	460 „	2 R 3 R	320 „
2 H's 3 H's	*380 „	2 S 3 S	*300 „
2 I's 3 I's	350 „	2 T 3 T	270 „
2 O 3 O	450 „	2 V 3 V	*230 „
2 B 3 B	400 „	3 W	210 „
2 P 3 P	360 „	3 X	*200 „

Whilst the speeds of Belliss & Morcom's engines are:—

Two-Crank.		Three-Crank.	
E C_1	*600 revs.	T E C_1	*500 revs.
E C_2, E C_3	575 „	T E C_2	450 „
E C_4	550 „	T E C_3	420 „
E C_5	*500 „	T E C_4	*380 „
E C_6, E C_7	450 „	T E C_5	360 „
E C_8	400 „	T E C_6	340 „
E C_9 E C_{10}	*380 „	T E C_7	*330 „
E C_{11}, E C_{12} ...	350 „	T E C_8	320 „
		T E C_9	310 „
		T E C_{10}	*300 „
		T E C_{11}	280 „

Now, a reference to the table shown in the left-hand column of this article shows that only those sizes of engines marked with an asterisk fit in with the standard periodicities (this being inclusive of 380 revolutions, which is included because it is only five revolutions faster than standard speed).

If the other engine makers' lists are gone through, they will be found to present the same difficulty. It is seen, therefore, that if we are to adopt standard periodicities at all, the initiative must come from the engine makers, at any rate, from such as make *high* speed engines.

Curiously enough, the discrepancies become less and less important as the speed is reduced, or in other words, as the number of poles of the alternator are increased (there must, of course, always be an even number of poles). For example, the difference between, say, 40 and 42 poles, which would be suitable for a slow running horizontal engine, is only 5 per cent., whereas between 14 and 16 poles, which are commonly employed for high speed engines, the difference is nearly 15 per cent.

Induction motors are now coming largely into use, and the three last columns are added to the table as they form a ready guide for approximate speed. On full load the speed of an induction motor, whether it be single, two, or three-phase, is lower than synchronous speed by an amount which is termed "slip." The slip varies with the design and output, but it is generally somewhere between 2½ per cent. for the large sizes and 7½ per cent. for the small.

Although the three last columns are filled in complete, it should be noted that there are mechanical and electrical (magnetic leakage) reasons why the number of poles for a given size of motor cannot be exceeded with a given output. For example, the synchronous speeds and the most convenient numbers of poles to use for a periodicity of 50 per second are as follows:—

	Synchronous speed revs. per minute.	Number of poles in stator.	Probable slip per cent.
Up to 7 B.H.P. ...	1,500	4	7½
7 B.H.P. to 35 B.H.P.	1,000	6	5
35 B.H.P. to 120 B.H.P.	750	8	2½

A 7 B.H.P. motor could be built with eight poles, in which

case the synchronous speed would drop to 750 revolutions per minute, but it would not be advisable to go much beyond that number.

The writer has pointed out elsewhere the necessity of the speeds of centrifugal pumps agreeing with the speeds of induction motors if the two are to be direct coupled, and here again, as with engines, the adoption of the Institution's suggestions for standard periodicities really lies with the centrifugal pump makers. They have got out certain lines of pumps running at various speeds, and the question is, is it going to be worth while going through the work again and adopting speeds which will suit the electrical engineer?

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The paper read and discussed at the meeting of the Institution of Electrical Engineers last week was on the rather unusual subject of "Electrical Time-Service," in which the writer, Mr. F. Hope-Jones, gave a full account of the various proposals and inventions connected with electric clocks, and particularly described his own ingenious devices of the kind. As was to be expected, the discussion was largely contributed to by rival clockmakers and inventors.

The first of these was Mr. A. J. Lund, who demurred at the division given in the paper, of electric clocks. Mr. Hope-Jones gave:—

1. Independent, self-contained, self-wound clocks.
2. Systems of clocks connected together by a line.

But Mr. Lund preferred to take three classes:—

(*a*) Impelled clocks, driven by a current sent from a central station.

(*b*) Controlled clocks, not allowed to go wrong.

(*c*) Synchronised clocks, set exactly right every hour.

He urged the advantages of clocks of class (*c*) which (1) did not leave the public without an indication of time if the line went wrong or batteries failed, and (2) could be re-synchronised without trouble when the current was again able to pass along the line. When a signal did arrive the hands were set right. He gave some amusing stories of experience with classes (*a*) and (*b*), and cited the objection many people had to the noise of a click—the tap, tap, every half minute; also referring to the "terrible question of battery power," which would be all the more acute if one had to "peg, peg away at the battery every half minute or less, instead of only once or twice an hour." Some reference to Pond's system, and the best position for a battery, closed his remarks.

Mr. H. T. Harrison spoke as having had some practical knowledge of the subject when electrical adviser to the company operating the Lund system. He said it took all available time to keep the lines in order, and thought it absolutely hopeless to use overhead lines in London for impelled clocks, while, if the question of permission to lay underground lines was disposed of, there remained the problem, would it pay to lay such lines for use with, say, 200 volts on a circuit with large self-induction, and, therefore, requiring good insulation? He was seriously doubtful whether the matter could be put on a financial basis, for the rental asked was equal to the interest on the money which would be spent on a very high class clock, which could be guaranteed to keep very nearly to time. If the system of hourly synchronisation only could be worked with a little more expenditure on the lines, accurate time service could be effected.

Mr. J. S. Raworth, in his usual amiable form, contributed the most amusing speech in the discussion. When we can get rival old-fashioned clocks rather than the modern system of the other inventor, it was, of course, obvious that it should be criticised, but he was not so pessimistic as Mr. Harrison. In large hotels there were often 500 or 600 clocks, and it was extraordinary how the clock winder ill-timed his visits. He had some experience of these clocks in Paris, and the noise of the thing was a drawback. When thinking "how wicked Paris was, and how good I was in comparison with it," the ceaseless click-click led to counting the ticks and wondering "if the thing ever stopped, the final result being a descent upon the switch placed in circuit," and peace. ["Could there be anything more ridiculous than a switch in an electric clock circuit?"—Mr. Hope-Jones in his reply.]

Mr. A. H. Bateman told the story of a clock he got for a Parish Hall at Lewisham, which has been working for two years. One 18-inch dial, one 12-inch dial in room 300 feet away, and other two smaller, have been in use, with Obach batteries as source of power, and they have worked "absolutely well, keeping admirable time," their only failing being to spoil "very pathetic love-making scenes in some theatricals," leading to "sulphurous language," and the threat that "if that thing was not stopped——!" A piece of felt carpet behind the clock reduced the click so much that it was quite inaudible. One of the smaller clocks had fallen from its fastening, and Mr. Bateman found it "hanging by its head" and everyone afraid to touch it, fearing they might get a "shock," but, "true to time," it had "gone on merrily, and very few ordinary clocks would have stood that ordeal." Altogether the experiences recounted were a good testimony to electric clocks, if not very dry science.

Mr. J. Stockall returned to the horological aspect of the question and went far deeper into the trade mysteries of the whole thing than we fear our readers would care to follow him. Then came Prof. S. P. Thompson, who referred to the Institution of Mechanical Engineers and the Surveyors' Institute as examples of recent buildings fitted with Mr. Hope-Jones's system. The slight troubles experienced there were due to causes which had nothing to do with the clocks even if they had not gone absolutely perfectly, was the remark of Mr. Worthington on being asked to give his experience with these clocks.

Prof. W. E. Ayrton asked the author whether the rate of going of the master-clock was affected by the time-constant of the circuit. Mr. G. W. Frodsham thought that the history of 30 or 40 years showed that an electrically-driven clock was not to be countenanced, for although, no doubt, those views might be modified, sometimes in practice such clocks failed. In Glasgow some years ago trouble was found. After describing an arrangement of his own for taking accurate time intervals recorded on paper, Mr. Frodsham gave place to Captain H. D. Acland, who thought it must be a source of satisfaction to Mr. Hope-Jones that there had been so little real criticism of his paper. He personally was interested as an amateur in the measurement of time, and gave an account of his own experience—a very favourable one—with Mr. Hope-Jones's clocks; even when on returning from a holiday he found the clock the home of earwigs and spiders, it had not stopped. His experience in experimental work—chiefly on gun ballistics—taught him that in case of obstacles the proper course was not to invent new things, but to remove the difficulty, and he was quite certain that the tap, tap of electric clocks, which at one time threatened to drive him perfectly mad, could be done away with if the cause of the noise was discovered. The altered movement of his own clock was now so silent, that it gave no annoyance whatever.

Mr. Hope-Jones, in replying, quoted German authors whose classification of clocks he had followed. The battery question was not so serious as had been made out, and the demand made upon the battery in his system was actually less than in many others. Insulating the clock movement, from anything which could act as a sound-board, by springs silenced the noise. A maintaining spring might be used in the master-clock, to get over any such difficulty as that suggested by Prof. Ayrton. He explained that the flooding of a conduit, blowing of a main fuse and earth on clock wiring accounted for the trouble alluded to by Mr. Worthington. This closed the discussion, and the meeting adjourned.

CORRESPONDENCE.

Signalling Without Contact.

I fear that both you and your readers must be getting tired of this subject, but still I do not like to leave "C. M. J.'s" last letter without reply.

"C. M. J.'s" method of answering questions is peculiar. I asked how a driver discovers the presence of an invisible signal. He replies with a list of points about the road which *may* and, of course, in many cases *do* enable the driver to know when he is in the neighbourhood of a signal post, but which, it is well known, do not always suffice. I asked what was the use of detonators if the signal could always be located without them (as "C. M. J." maintains) and assumed to be at danger. In reply, we are told that detonators and lamps are used for signalling—which was pretty well known before. The answer to my third question—What can a driver, otherwise unable to locate a signal, do but "assume that the line is clear if he does not hear a detonator explosion"?—is simply the old tale about assuming the arm at danger. To question four, however, the answer is direct—praise of the old method is not criticism of the new. I am glad to find that we are agreed on this point, at all events. The reason why it is easier for the driver to read signals that he has to pick out from others in the air than those, without surrounding ones, given before his face on the engine is that he can do several things at once! To the question, Where are trains to be seen running through four block sections per minute? the answer is that "there are many large station yards where the signal boxes are often not more than one-eighth of a mile apart." I leave comment to readers.

It is, at all events, consoling to find that "C. M. J." does not condemn my system *in toto*; and I am much obliged to him for expressing the opinion that I have "got hold of the right principle." This is another point of agreement between us.

W. S. Boult.

The Wilson Enclosed Motor.

I notice in your issue of December 8th a description of the "Enclosed Wilson Motor." Permit me, through your valuable paper, to point out that an identical machine to this, embodying the same special features as claimed by Wilson, was designed by me in the early part of 1896. In my design, both round and rectangular field magnets were employed (both detachable and cast to the outer shell of the magnetic circuit). These motors were manufactured by John Elmondson, of Leeds, and are now made by Mr. Thomas Barton, the Electric Works, Weir Street, Blackburn.

There are several motors from 1 to 25-H.P., working in different parts of the country. Messrs. Slingsby, Limited, Bradford, are driven exclusively by them from the Corporation supply.

Thomas Preece.

Board of Trade Regulations.

A note in your issue of the 8th inst. relating to this subject raises an interesting question. You say, or rather you quote from a contemporary, that "many engineers have considered that a 2 × 220-volt *alternating* current three-wire system comes within the category of high pressure supply," and you say that this applies to the distribution system. Presumably your dictum is based on the B.O.T. Regulations for 1896, Sections 1 to 5.

If your interpretation of these regulations is correct, then, by the ruling of the same regulations, a three-wire *direct* current traction system, employing anything under 500 volts on either side of the neutral, is a high pressure system.

I have always assumed, perhaps wrongly, that if the B.O.T. officials were to be asked why they tolerate a 500-volt trolley system of the ordinary type, they would reply that, so long as the 500 volts was not exceeded, they were not departing from their own regulations in sanctioning the use of a bare trolley wire overhead.

The question whether the same regulation applies in the same sense to a three-wire direct current 2 × 500-volt system seems of interest in view of the possible introduction into this country of this system in particular cases. If it applies, then presumably no bare trolley wires are permissible.

What, then, is of importance is the following sentence in the B.O.T. Regulations for 1896:—"The expression 'pressure' means the difference of electric potential between any two conductors through which a supply of energy is given, *or between any part of either conductor and the earth.*"

Now, if the latter half of this definition is an alternative and may be taken by itself, a three-wire direct current 2 × 500-volt system having the "neutral" earthed is a *low* pressure system, provided the 500 volts be not exceeded.

But, according to your dictum, a three-wire 2 × 250-volt alternating system having the neutral earthed is a *high* pressure system.

Are the two conditions of the definition quoted above quite inseparable? And, if so, by what process does the London United Tramways Company hope to gain official sanction to the three-wire 2 × 500-volt system?

A. M. Taylor.

A Hydro-Electrical Phenomenon?

A few days ago I was asked to report on the curious action of a steam boiler installed at a works in Birmingham where the electric light was in use. It was noticed that a person walking over the boiler on a wooden staging was liable, on approaching his hand to one of the supporting pillars of the yoke, through which the stem of the main steam valve screwed, to receive a severe shock, and could obtain a spark from ¼ inch to ⅜ inch long between finger and pillar.

The owners were afraid this was due to leakage from their electric plant. I explained it in the following manner:—Finding that on placing my foot on the plates of the boiler the spark could not be obtained, yet when standing on the wood it could, and as there was a considerable leakage of steam from a bad joint at the base of the pillar and all round it, I must have formed a species of Leyden jar to receive electricity from the pillar, it being brought to a high potential by the friction of the steam escaping through somewhat intricate passages at the base of the pillar, much on the same principle as Armstrong's hydro-electrical machine. I should like the opinion of your readers on this point, also as to whether it has been noticed before, and if it could have any bearing on the subject of your paper by F. S. Spiers on "Corrosion in Boilers," or would the presence of high voltage electricity at a leaking joint affect the plates?

Hugo Gibson.

Birmingham, *December 16th*, 1899.

Single-rail Tramways.

My attention having just been drawn to an article that appeared in your issue of May 19th last upon Monsieur H. F. Caillet's single-rail tramway, and to your remarks thereon, I have the pleasure to send you herewith a reprint from the *Journal of the United Service Institution of India* of "Notes on *Ewing's* Patent Single-rail Tramway, with reference to its adaptability to military purposes," by Lieut.-Colonel F. F. R. Burgess, I.S.E. The single-rail tramway therein referred to was patented by me in the United States of America, India, England, all the Australian Colonies, the Cape, Natal, Brazil, the Argentine Republic, and other countries in 1895. I also send you a photograph of a single-rail tramway which was worked in 1881 on exactly the same principle as the *so-called* Monsieur Caillet's invention is now. The photograph shows the line and truck as invented and exhibited by me on the Parade Ground at Dibrugaak, Upper Assam, so far back as 1881, before Field-Marshal Sir Donald Stewart—then General Sir Donald Stewart, Commander-in-Chief in India, General Sir George Greaves, then Adjutant-General, and the late General Sir Charles Macgregor, then Quartermaster-General in India. Among others who were present on that occasion were Lieut.-General Chapman, C.B., now commanding H.M.'s forces in Scotland, and who was then Military Secretary to H.E. the C-in-C. in India; General Nation, C.B., commanding our Eastern Frontier District (Assam); Colonel Way, Assistant Adjutant-General, Eastern Frontier District; and Colonel H. M. Evans and officers of the 43rd Assam Light Infantry. On this occasion 175 yards of the line were laid ready for work by 40 *recruits* of the 43rd Assam Light Infantry in 6½ minutes, and from H.E. the C-in-C. and his staff I received warm congratulations on having invented a means of transport that all said would have been invaluable during the recent Cabul war.

My reasons for abandoning that system were (1) the width occupied, owing to the animals being at the side, the yoke at the end of the cross-pole, shown in the photo, being used for bullock power; and (2) that no matter whether the truck was fully laden or quite empty, the animal at the side was still necessary to balance each truck, and a *train* of trucks could not be taken by one pair of bullocks, horses, mules, or any other animals, and electricity or steam could only be applied in the manner you suggest in your remarks.

On my present system a pair of Indian bullocks can draw a *net load* of 7 tons in one, two or more trucks, and steam, electricity, or any other motive power can be applied as may be desired.

The most economical method of working the tramway would be by means of a traction engine with its driving wheels on the *road*, and all the load behind it in trucks on my system on the single rail. As the use of the rail increases the load that a pair of bullocks can draw on a first-class metalled road ($\frac{3}{4}$ of a ton) to 7 tons *net load*, a traction engine with its driving wheels on the road or ground that can haul a gross load of, say, 10 tons behind it in the usual way, should be able to draw 100 tons were the load on the rail, as on my system. The only drawback to this would, when the tramway was laid on a *road*, be the necessity for laying the rail some 4 feet in from the edge of the road, to allow the driving wheels to run one on either side of the rail, whereas, with animal power as I use it, the rail can be laid on the extreme edge of the road, except where it crosses bridges, when it must be carried further out towards the middle of, and the rail laid flush with the surface of, the road, as with ordinary railway level crossings. Were an engine specially designed to run with its drivers on the rail, the latter would have to be increased in weight to carry the weight on the driving wheels of the engine, and so the heavier the weight to be drawn by the more powerful, and necessarily much heavier engine, the greater would be the weight *and cost* of the tramway; *but* with a traction engine having its driving wheels on the ground, the light *and cheap* tramway would do equally well for a light or heavy load, the load in the latter case being carried in a greater number of light trucks with stronger couplings than would otherwise be necessary. For this combination of my single-rail tramway and a traction engine I claim that it would be the simplest and cheapest method of land transport that has ever been invented. I forgot to add that another illustrated account of my tramway, by Lieut.-Col. A. J. Kelly, R.E., was published in the *Royal Engineers' Journal* (published at Chatham) of October 2nd, 1899.

Chas. Ewing, C.E.

Adyar, Madras,
November 21*st*, 1899.

Berrenberg Lamps.

With reference to an Editorial paragraph relating to the Berrenberg incandescent lamp appearing on p. 974 in your issue of the 15th inst. (and to which my attention has just been drawn), I must ask you to allow me to make a few observations on the same.

You publish as the result of what you state to be "an absolutely impartial test of initial candle-power and efficiency" a table of figures relating to four 16-C.P. and six 32-C.P. 100-volt lamps of the 2½-watt 1,000-hour class, manufactured by the Berrenberg Syndicate, under my own supervision, and which were sent to you with the invitation that certain tests should be made. You go on to point out that the figures in question show a deficiency in the candle-power of one-third below the marked values, the aggregate watts per lamp, however, working out at even less than we claim for the marked candle-power.

Taking the last-mentioned point first, we are not surprised to find we are practically at one—it is so easy a matter for anybody and everybody to put a lamp on the ammeter and see at once the consumption in amperes of current.

The question of photometrically deciding on the candle-power given, is, however, a much more involved question, and figures to be of any value in this respect require, as every electrician knows, some explanation. What standard of candle-power are we to understand was adopted, and what instruments were used? The results obtained by different methods and by different instruments when measuring for candle-power are as wide as the hills. I am not disposed, therefore, to accept figures blindly, and in the absence of any such information, your figures tell us nothing.

The Berrenberg lamps are made to, and marked for, "English standard candles." In the absence of any other reliable means of measuring a candle, the "Hefner candle" is used. This instrument, designed and made to register the "German candle," is examined, passed, and stamped by the German Government, and is the only instrument in the world franked with Government authority. The ratio of the "English candle" to the "German" is as 114 to 100, and it is working on this ratio that the Berrenberg lamp candle-power is arrived at. If anybody can point us to a better method it will be willingly adopted.

Respecting the suggestion that perhaps on 106 volts these lamps would give their marked candle-power, I desire to say that all lamps made by us are made to give the life claimed, and the proper candle-power at the E.M.F. marked on the lamp.

What we asked you to do before, and what I now ask you to do again, is to purchase 12 of the best of similar English lamps (at my expense) as the 12 100-volt lamps I am willing to send you. Let these lamps be tested by the same "impartial authority" in my presence, or in that of a representative of the Berrenberg Syndicate, each lamp of each make to be tested alternately for initial candle-power and current on the same day, and measured by precisely the same photometer and instruments, and the record of each lamp published in the Review.

It matters not thus whether your photometer reading gives us 16 C.P., 10 C.P., or even 5 C.P., the fact that we are giving more light than the others, and that the ratio of difference can be ascertained, and the claim made by us that we give more light with a lower consumption of energy be readily proved or refuted, gives something tangible in the way of a lamp test.

I, personally, am willing to make myself responsible to pay to the person who can produce any other lamps on the market, giving the candle-power, combined with high efficiency and long life of the Berrenberg lamps, the sum of £100.

With reference to your concluding paragraph about a test of 200-volt lamps, I will ask you to kindly allow me to refer to these in your next issue.

A. Berrenberg.

December 20*th*, 1899.

Tested Lamps.

It is an easy matter for your correspondent to say that my experience with lamps is "very limited," but he must remember that I could just as easily say the same about him. I have already acquired the information that he kindly gives me *re* the "flashing" of filaments.

Strange as it may seem, I know that at least one lamp maker puts gas into his bulbs. His lamp is a very good one, and the "whole thing" does not "explode." I do not, of course, say that an "explosive" gas is used, and I need hardly add that the gas is under reduced pressure, indeed, I think, considering the low pressure in the bulb, it would be a difficult matter to make even an inflammable gas explode.

Few lamps with which I have had to deal have had a vacuum by any means perfect. A good authority on electrical matters says that if a lamp has a perfect vacuum the carbon of the filament dissipates.

When I spoke of efficient lamps, I meant "efficient" over a life of 600 hours.

I have not missed the point of contention, which, as far as I am concerned, was the "consumption of current," not the "inexplicit report," which I see was only an abstract. I will ask your correspondent to refer to Sir W. H. Preece's "Electric Glow Lamp Tests" (Electrical Review, Nos. 983 and 984), he will there find a few instances of the current rising as the lamp burns.

The 100-volt lamps which I have tested have generally been "flashed," so in this point, at least, we agree.

On reading a letter which appeared in the *Electrical Engineer* of December 8th, I find attention is there called to

an error your correspondent appears to have made, the ·017 increase he speaks of being really only ·007 ampere increase.

F. P. S.
Electrical Engineer.

MIXED SYSTEMS.

One of the leading lessons learnt by the members of the Institution of Electrical Engineers, who recently investigated the Swiss electrical supply systems, was that in Switzerland a hard and fast system was not prescribed for every town or locality, every place being treated on its merits, and such treatment frequently leading to diverse systems in different parts of the same locality.

A well-known North-Country electrical engineer, who has just returned from an extensive tour in the United States, finds a like state of things there.

The central station engineers responsible for work in the United Kingdom have, hitherto, in the main, ignored the great advantages arising from so-called "mixed systems." We say "in the main," because there have been exceptions. Prof. Kennedy, at Edinburgh, and Mr. Arthur Wright, at Brighton, have both availed themselves of the advantages arising from *feeding* their central areas by means of low pressure currents, and their outside areas by means of high pressure.

The electricity works at Sunderland were designed from the first to carry out a similar principle, while the method has also been adopted at the Blackburn, Preston, St. Helens, and Southampton works. From a recent report drawn by Mr. Robert Hammond for the Corporation of Sheffield, we see that one of his former assistants, Mr. Arthur T. Cooper, at Reading, has very successfully substituted a low pressure supply for the high pressure supply, within a mile radius from the generating works. We gather from the same source that Sir William Preece and Major Cardew are about to adopt a similar plan at Yarmouth.

Considering, however, the number of central stations in the kingdom serving areas which include both congested districts in close proximity to the works, as well as scattered districts on the outskirts, it is surprising that in only some half-dozen places has the "mixed system" plan been adopted.

It is true that engineers in charge of low pressure works have had less need to adopt "mixed systems" than their high pressure brethren; they have been immensely assisted, first by the introduction of the three-wire system, and then by the raising of the voltage of the incandescent lamp, these two improvements combined making low pressure distribution possible at distances from the generating works which formerly could only be reached by high pressure.

Starting with systems designed to cope economically with the district immediately contiguous to the works, low pressure engineers have been able to cope with the outskirts by the gradual improvements grafted on to their original methods.

On the other hand, high pressure alternating engineers have had no such devices prepared for them, and alterations of their supply had necessarily to be radical ones, with the result that, dealing with systems admirably adapted for distant and scattered lighting, they have clung to the same, even when their high pressure feeding necessitated the use of transformers for the supply to consumers just round the corner.

To such, we venture to say, follow the example set by Reading, and take steps to avoid the magnetising watts expended, or, commercially speaking, "lost" unnecessarily.

A better illustration could scarcely be afforded than that of Sheffield, where the distribution of the load appears to be :—

Consumers within ½ mile radius of the generating station	756	kw.
" between ½ mile and 1 mile	114	"
" between 1 mile and 1½ miles	104	"
" beyond 1½ miles	133	"
	1,107	"

It will be seen that 68 per cent. of the load is located within ½ mile of the works, 78 per cent. within 1 mile, and 88 per cent. within 1½ miles.

Here, surely, is a case where the new money spent by the Corporation on the undertaking might have been spent wisely in providing low pressure plant for supplying the consumers near at hand, instead of piling it, as they apparently have been doing, into high pressure plant, a contract for an additional 1,000 kw. set having only recently been signed, with the result that by the time the expert arrives on the scene the purse strings are tied.

Central station engineers cannot be too strongly urged to cast off hard and fast trammels, and, when spending the money ungrudgingly placed at their disposal by town councils or by directors, to consider well the claims of "mixed systems."

This advice is tendered especially to the high pressure single-phase alternating men, some of whom seem to hold tenaciously to the opinion that "magnetising watts," like poets, are "born, not made." These gentlemen dwell under the delusion that an extra pinch of coal is all that "magnetising watts" need for their production, ignoring the fact that every pinch becomes a handful in the "wee sma'" hours of the night, and in the daytime when the works are kept in operation mainly for the purpose of churning the air and turning out "magnetising watts."

The cost of production of the latter, therefore, must be deemed to include a proportion of the wages bill, repairs, maintenance, depreciation, rent, &c. Some see the force of this argument in the case of those works where the "magnetising watts" are sufficient to fully load up a complete set of plant; but obviously the principle stands good whether half a set, one set, or two sets be used, or, indeed, whatever the call upon the plant may be.

If by a stroke of Providence the onerous necessity for producing "magnetising watts" were mercifully suspended for a few weeks at winter time, we fancy that the generating plant thereby set free in the stations of the Metropolitan Company, for instance, would prove sufficient to cope with the overload which, plus the magnetising watts, broke down their supply last week.

Even the ingenious gentleman who has recently been circularising us with offers of perpetual motion machines of all sorts, has not ventured to claim that he can, with our present knowledge, produce magnetising watts out of coal alone, and we do not think they will succeed in doing that even in Sheffield.

The worthy president of the Institution of Electrical Engineers will see with some surprise that his Presidential Address is being used in Sheffield to show that he is an opponent of mixed systems, and that, in consequence of the Swiss trip, he is an advocate of the use of high pressure alternating currents, even when the bulk of the consumers are situated within half a mile of the works.

We fancy that if Dr. Silvanus Thompson were to descend from the Professorial Chair in order to design a plant to suit the above conditions, he would hardly deem it necessary to waste one-third of the units generated in the form of magnetising watts.

What the President did say was, that the time had come when the distribution to consumers would be by low pressure multiphase instead of continuous currents.

Since the displaying in the Sheffield newspapers of the President's remarks, as a means of discrediting Mr. Hammond's advice, seems to have befogged the town councillors there, we venture to say to Sheffield and the other places where mixed systems appear to be desirable, don't let the minor problem of the ultimate distribution to consumers obscure the much more important problem of the best method of "feeding."

Mr. Hammond's main contention is that in Sheffield the magnetising losses in the supply to the central area should be abolished; and all those unshackled by prejudice will agree with him.

His minor contention, that the distribution to consumers in the central area should be by continuous currents, will also, we feel certain, have the almost unanimous support of those who have had extended experience of the many advantages accompanying their use.

THE POSITION OF THE ELECTRICAL HEATING INDUSTRY IN THIS COUNTRY.

(*Concluded from page* 955.)

A good deal of the annoyance introduced by heating apparatus giving way suddenly and leaving the users in the lurch can be avoided and guarded against by having spare parts, and we are inclined to think that if this point had only been observed by the trade when supplying apparatus, the bad name which heating apparatus has to some extent gained for itself for being unreliable, would have been largely avoided.

It must not be inferred from this that all heating apparatus is continually giving way, as, whilst some articles, such as flat irons, goose irons, and other apparatus getting up to about 500° F. are liable to break down, others, such as radiators, hot plates, &c., working at a lower temperature, very seldom give way.

In a complete installation, however, one is obliged to have some of the troublesome articles, and delay and annoyance consequent upon these breaking down must be reduced to a minimum by having spare articles.

We do not wish to propose that every user of heating apparatus should have a complete spare plant, but rather that the local supply company or contractors who lay themselves out for selling or hiring out apparatus, should keep a supply to avoid the necessary delay incurred in sending apparatus back to the manufacturers.

Electric radiators are coming more and more into daily use for heating spare rooms, bed rooms, sitting rooms, offices, &c., not exceeding about 5,000 cubic feet in volume each.

When this size of room is exceeded, however, the points in favour of electrical heating begin to decrease, until the power required becomes so great that the scheme becomes impracticable from point of view of running cost, excepting in certain cases where there are reasons for preferring the electrical system.

For rooms under this size, however, electrical heating is quite practicable, and for intermittent heating the cost will compare favourably with other systems, even when used off the central station supply.

For continuous heating, however, say for six or seven days a week and all through the day, the cost of electrical heating will come out expensive when compared with other methods, unless there are certain conditions pointing in favour of the electrical system, such as one finds in all theatres, music halls, &c.

The chief advantage of electric radiators for heating purposes lies in the fact that they are always ready for use, can be switched on and off as required, can be moved about from room to room, and, finally, require nothing but two wires to connect them.

The points of cleanliness, safety from fire, and absence of any smell, will also testify in their favour.

The amount of power required for electrically heating any room, depends greatly upon the amount of glass surface in the room, as well as upon the draughts and admission of cold air, which again are governed by the frequency with which the doors are opened.

It can be taken, however, for a guide that 500 watts will be required per 1,000 cubic feet of volume, and that the full power will be required switched on for between two and three hours during the coldest winter days, for first heating the room up to about 65° F.; after this the power can be reduced to $\frac{1}{3}$ or $\frac{1}{2}$, depending upon circumstances.

It should be borne in mind when comparing the cost of one system with that of another, that, thanks to the absence of dirt and dust with electric radiators, the annual cost of whitewashing, repapering, &c., is considerably reduced.

Radiators for heating yachts and ships are coming more and more into general use, and when it is considered that two small wires take the place of the ordinary cumbersome steam-piping, this is scarcely to be wondered at. On board ship the steam radiators themselves are quite bulky enough, though space can often be found for them, but when in addition to this, space has also to be found for the pipes bringing the steam to the radiators, it is little wonder that a system necessitating very much less space is commanding considerable attention. Radiators are also being introduced for theatre heating, and here again they have several great advantages.

For heating the stalls, for instance, it has been found advantageous, in addition to fixing a number of radiators along the sides or under the skirtings, to have several portable electric radiators in the stalls themselves, which can be removed to the sides as soon as the performance commences. There they are still giving out heat, and not interfering with people passing in and out.

The best designs of electric radiators are made to have a free draught and circulation of air through them, as it is found that, by enabling cold air to come into contact with both the front and back of each radiator plate, better effects can be obtained than by closing the case up, and obtaining heat by radiation only. In the former case, the radiator acts both as an "air warmer" and radiator, whilst in the latter case it acts as a radiator only.

When acting as an "air warmer," the plates keep a good deal cooler than when acting as a radiator, which alone is some advantage.

As to the question of cost of the necessary electric heat radiators complete, it can be taken as a guide that the first cost works out as below, which includes the radiator, regulating switches, and necessary flexible for connecting to nearest wall plug :—

Rooms up to 1,000 cubic feet in volume at 6s. per 100 cubic feet.
Rooms up to 2,500 cubic feet in volume at 4s. 6d. per 100 cubic feet.
Rooms up to 5,000 cubic feet in volume at 3s. 6d. per 100 cubic feet.

III. The third case in which electric heating and cooking apparatus is used as a supplement to the existing system is, perhaps, the one in which more strides have been made than in any other. The applications are certainly small ones, but, at the same time, when it is remembered that every house with the current on has a use for these applications, it will be appreciated that the total load derived from this source is not an insignificant matter to the electric supply company.

Among these smaller applications may be mentioned :—

1. Kettles for keeping water boiling during teatime, and taking the place of small spirit lamps.
2. Different sizes of hot plates for keeping dishes and plates warm during a meal.
3. Egg boilers, and other small water boilers, such as shaving pots, &c.
4. Ladies' curling iron heaters, which consist in a round tubular heater, into which the curling iron to be heated is inserted.
5. Bronchitis kettles.
6. Flat irons for ladies' use, or for use in private laundry.
7. Cigars and cigarette lighters.
8. Radiators for use in bed rooms or sitting rooms not continually in use.

Lastly, as to whether a heating load is one which is likely to benefit the central station supply.

We are of opinion that if this heating business were taken up more energetically by the central station authorities, the load derived therefrom would be very much to their advantage.

It must not be overlooked, however, that a certain percentage of the heating load would, in all probability, overlap the lighting load, though the maximum heating load would come on during the daytime, and most probably to a greater extent during the summer months than during the winter months, as in the summer one tries as far as possible to dispense with an open fire, and electric cooking steps in here to great advantage.

The load derived from heating apparatus in use in factories and works is likely in some cases to be quite as large as the load derived from private houses, and the factory load is not so likely to overlap the lighting load to any appreciable extent. The nature of the heating load is, of course, bound to vary very considerably in each district.

In spite of this slight overlapping, however, of the two loads, it would seem as if the heating load were one worth attention and encouragement. To properly cater for this load would necessitate a showroom for the purpose, in which the apparatus could be shown at work, and, further,

some system for hiring out the apparatus to customers, whereby they might try and see for themselves whether it suited their purpose before deciding to purchase.

In some cases it would pay to hire out the apparatus at a nominal rental.

Further, spare apparatus must be kept to minimise any inconvenience caused by apparatus giving way.

We are of opinion that if steps were taken to push and introduce heating apparatus somewhat on these lines, the load to the central station would be beneficial, without involving much trouble and expense.

Surely, with current as cheap as it can now be obtained in some of our larger towns, great advance can be expected in this branch of the electrical business.

LONDON COUNTY COUNCIL.

The Council at the meeting on Tuesday further considered the question of lending £16,500 to the Bermondsey Vestry for a site for an electric light and refuse destructor station, and decided to grant a loan to that extent. It was also resolved to lend £30,000 to the Hackney Vestry for electric lighting purposes, £13,605 to the Poplar District Board for the erection of a generating station, and £20,000 to the Whitechapel Board for electric lighting purposes.

London United Tramways.

Mr. J. W. Benn, chairman of the Highways Committee, obtained the consent of the Council to the substitution of a fresh report to that presented in October in reference to the detailed drawings submitted by the London United Tramways Company for the approval of the Council relating to the electrical equipment of certain tramways in Hammersmith, as sanctioned by the company's Act of 1899. It may be remembered that this Act requires that an underground system of electric traction shall be adopted for the tramways from Young's Corner to Hammersmith Broadway, and thence along Beadon Road, Glenthorne Road, and Studland Road, and that part of The Grove between Beadon Road and King's Street West; and the drawings submitted by the company showed those lines on that system.

The Committee now stated that both before and since the former report was submitted, strong representations had been made by the inhabitants of King Street, Hammersmith, and by the Vestry, of the inconvenience and probable loss which would be caused to the tradespeople in that thoroughfare if the carriageway were to be disturbed for the construction of an underground system; and that the company had given notice of intention to ask in the next session for such an amendment of the Act as would permit of the lines referred to being equipped for an overhead system.

Without expressing any opinion with regard to the proposed amendment of the Act, the Committee thought that, in the circumstances, the Council might approve of those of the drawings submitted which relate to the lines which, by the Act, are authorised to be equipped for an overhead system. The adoption of that course would not prejudice the Council in any action it might think well to take with regard to the proposal for the amendment of the Act, but, at the same time, it would facilitate the company's operations with regard to the other lines. The Highways Committee accordingly presented the following amended recommendation, which the Council unanimously adopted:—

That the sanction of the Council be given to the plans and particulars submitted by the London United Tramways Company, under the provisions of its Act of 1899, and the agreement with the Council scheduled thereto—(*a*) for the overhead, or trolley, system of electrical traction to be adopted for the company's tramways in the Uxbridge Road between the Askew Arms public-house and the Uxbridge Road railway station, and in Uxbridge Road and Goldhawke Road between the railway station and Young's Corner; such sanction being, however, given without prejudice to any action which the Council may decide to take with regard to the proposal of the company for the amendment of the provisions of its Act of 1899 with regard to the equipment for an underground system of electrical traction of its lines between Young's Corner and Hammersmith Broadway, and in Beadon Road, Glenthorne Road, and Studland Road and part of The Grove, and, moreover, subject to the following conditions—that the trolley wires be not attached to the electric lighting standards of the Vestry of Hammersmith; that the company do furnish to the Vestry detailed drawings of the inspection chambers and boxes proposed to be placed in the carriageways or footways; that the "Bristol" designs for the side and centre traction posts be used; but the cut-out circuits be of such length as shall be approved by the Council's chief engineer.

The Default of the M.E.T.

The Highways Committee, in a further report, referred at some length to complaints made that the Metropolitan Electric Supply Company had nightly, for some weeks, discontinued the supply of electric light for some hours at a time in the district of Marylebone. The letters from the original complainants, dated December 4th and 7th, stated that interruptions of the supply had occurred on various dates between November 20th and December 7th. The company's attention was called to the interruptions specified in the letter dated December 4th, and stated, in reply, that interruptions on November 29th and 30th were caused through a fatal accident to the driver of one of the engines, and that on the 28th through the bursting of a main steam joint; and further, that difficulties had arisen in the starting of the new machinery, and that these had been seriously increased, as the impossibility of obtaining proper supplies of Welsh coal affected the efficiency of the works.

It appeared clear, in the opinion of the Highways Committee, that the Board of Trade regulations as to the supply of energy under the company's order had not been complied with, inasmuch as the company had without the consent of the Council and of the local authority, failed to maintain a constant supply. Section 2 of the regulations above referred to required that the undertakers "shall maintain a supply of sufficient energy for the use of all consumers entitled to be supplied . . . and such supply shall, except so far as may be agreed upon from time to time between the County Council, the local authority, and the undertakers, be constantly maintained; provided that for the purposes of testing, or for any other purposes connected with the efficient working of the undertaking, the authority by whom the electric inspector is appointed may give permission to the undertakers to discontinue the supply at such intervals of time, and for such periods, as that authority may think expedient; when the supply is so discontinued notice of such discontinuance, and of the probable duration thereof, shall be forthwith served upon the County Council and the local authority."

The company's order and the Board of Trade regulations provided for the imposition of penalties not exceeding under the order 40s. a day, or under the regulations £5 a day, in case of default of supply; and, as the repeated interruptions of the company's supply had caused serious inconvenience to those consumers who had discarded other means of illumination, the Highways Committee thought that proceedings should be taken against the company to recover penalties in respect of default in not maintaining a constant supply, and they submitted a recommendation to that effect.

Miscellaneous Matters.

The Asylums Committee asked the Council to approve of an estimate of £850 for preparing schemes for the provision of a central station for the supply of electric light and water on the Horton estate.

It was decided to approve plans submitted on behalf of the City of London Electric Lighting Company for the erection of an extension of the company's generating station in Sumner Street, Southwark.

The Council resolved to approve plans submitted by the engineer of the City and South London Railway Company for the erection of a new station at the north-east corner of Old Street and City Road. At the same time it was decided to negotiate with the company with a view to the corner of the station buildings being rounded off so as to permit of the kerb being similarly dealt with, and so avoid a sharp turn to the footpath.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Dec 20th, 1898.		Week ending Dec. 19th, 1899.	
Adelaide	Value £33	Adelaide	Value £130
Amsterdam	55	Alexandria	120
Antwerp	65	Amsterdam	60
Auckland	228	Auckland	100
Bombay	240	Bahia. Teleg. instruments	57
Boulogne	60	Bombay	108
Brisbane	129	Bordeaux	32
Calcutta	846	Boston	25
Cape Town	144	Boulogne	34
Chinde	16	Bremen	22
Christiania	45	Buenos Ayres	1,214
Colombo	69	Calcutta	201
Copenhagen	23	Cape Town	85
Durban	99	Chinde. Teleg. mat.	86
East London	861	Christiania. Teleg. cable	453
Ghent	195	Colombo	951
Halifax	27	Durban	28
Hamburg	120	Gibraltar	31
Hobart	103	Halifax. Teleg. apparatus	2,500
Malta	223	Hamburg	30
New York	86	„ Teleg. mat.	200
Ostend	36	Hong Kong	15
Port Elizabeth.	9	Launceston	37
Rangoon	92	Madeira	43
Shanghai	30	Madras	116
„ Teleg. mat.	147	Malta. Teleg. cable	13,680
Singapore. Teleg. mat.	117	Melbourne	162
Suez. Teleg. mat.	516	Ostend	85
Sydney	41	Port Chalmers. Teleg. mat.	200
„ Elec. cable	1,625	Port Elizabeth.	19
Vigo. Teleg. mat.	45	Rangoon	100
Wellington	49	Santander	30
„ Teleg. mat.	579	St. Lucia	21
		Stockholm	28
		Sydney	1,193
		Tokio. Teleg. cable	73
		Yokohama	143
Total	£6,414	Total	£22,407

Foreign Goods Transhipped.

Bombay	Value £50	Barbados. Teleph. apparatus Value £1
Brisbane. Teleg. mat.	148	
Sydney	541	
Total	£739	

Asylum Lighting.—Messrs. Coates & Sons, Belfast, have secured the contract for the electric lighting of Cork Lunatic Asylum.

Annual Gathering.—The annual social gathering of the employés of Mr. James White was held in the Queen's Rooms, Glasgow, on Friday night, the 15th inst., at which between 800 and 900 of the employés and their friends were present. Lord Kelvin presided, and among those on the platform were Prof. Barr, Dr. Bottomley, Mr. David Reid, and Mr. James Ferguson. The chairman, in a few remarks, said it would be interesting to the employés and their friends to know that this was the jubilee year of the factory of James White. Instituted in Renfield Street, Glasgow, in 1849, it was not such a large factory then as it is now, but good work was done then as good work was being done at the present time. Having referred to the business abilities of the founder, James White, and especially to his ingenuity and zeal in entering on new work, Lord Kelvin touched on the progress of marine telegraphy, and observed that the first messages ever sent under the Atlantic were transmitted and received by instruments made in James White's factory. In congratulating the employés on having started a fund in aid of the families of reserve men working in the factory who had been called out to the war in South Africa, his Lordship expressed the hope that the war would be speedily brought to a conclusion, but patience must be exercised. The whole British nation must persevere until this had been brought to a satisfactory conclusion. He predicted that 10 years hence, when the two Republics became part of the British Empire, the Boers, freed as they would be from the terrible servitude of commandeering, would be happier than they had ever been, and under a government of liberty, and good subjects of Queen Victoria. An enjoyable musical programme was afterwards submitted, and a dance followed.

Bankruptcy Proceedings.—At the London Bankruptcy Court last Tuesday a sitting was held for the public examination of E. A. Max Winter, electrical engineer, Amberley House, Norfolk Street, Strand, who applied to pass upon accounts showing total liabilities £1,550 3s. 3d. (unsecured £975 3s. 3d.), and assets "a bad debt for £157 10s." Under examination by the Official Receiver the witness stated that he had carried on business at the above address as the Imperial Electric Light and Power Company, having started in May, 1897, with a capital of £700 or £800. His idea was to obtain concessions from public bodies and others for the supply of electricity and after the business was successfully established to convert it into a limited company. His labours, which took him all over England, Scotland, Ireland, and Wales, resulted in the obtaining of one concession, on which he paid a deposit of £500 on the purchase price of £15,000. He subsequently sold that option for £2,500, including the deposit, and that was the only business he really carried through, the result being that the idea of transferring the business to a company had to be abandoned. Witness had entered into a contract with his father-in-law to construct an electric railway in the grounds of the Alexandra Palace. He sublet that contract on terms that he was to receive a half share of the net profits, but the undertaking resulted in a loss. Witness attributed his failure to heavy business expenses against small returns, and pressure by creditors. The examination was concluded.

The *London Gazette* contains notice of a first and final dividend of 6d. payable on January 1st, 1900, in the case of J. E. Stott, electrician, of Huddersfield. Payable at 8, Princess Street, Huddersfield.

A receiving order has been made against F. B. de Foe Paynter, electrical engineer, of Catford (late Chiswick), at the Greenwich Court on a creditor's petition.

The examination of S. F. Walker, electrician, Cardiff, was closed at the Cardiff Bankruptcy Court on 14th inst.

Liquidation Notice.—A meeting of F. H. Royce & Co., Limited, is to be held at the Chartered Accountants' Institute on January 18th, to hear an account of the winding up operations from the liquidators, Messrs. F. H. Royce and E. A. Claremont.

Bullock's Works.—Following our notice of Bullock generators last week, we receive the intimation that the Bullock Electric Manufacturing Company, of Cincinnati, is now advertising for bids to extend its main building 200 feet. This extension has to be speedily effected, to cope with the increasing business. The main machine shop will then be 500 feet long × 101 feet wide.

Calendars and Catalogues.—Messrs. G. M. Callender and Co., of Victoria Street, S.W., have issued an illustrated list of water-tight reservoirs in connection with the use of their bitumen sheeting. A reprint is given of a paper explaining the lining of a reservoir near Whitby, in which bitumen sheeting is used for the floor.

Messrs. D. Stewart & Co., Limited, of Glasgow, have issued a wall calendar with monthly slips. A view of the "Glasgow" patent water-tube boiler appears thereon.

Messrs. Buck & Hickman, of Whitechapel, have issued a new English catalogue of tools and machinery dated 1900. The volume is beautifully and strongly bound, and contains 500 pp. of excellently printed illustrations and press matter descriptive of the firm's manufactures and specialities. The book contains a thousand and one items ranging from large plate edge planing machines down to small hooks and staples, and its collection of lathes, drilling, screwing, milling, punching, shearing and shaping machinery, pulley blocks, lifting jacks, vices, smiths' hearths, rail-benders, overhead and wharf cranes, winches, pulleys, saw benches, grindstones, wood-working machines, and a whole host of sundry accessories and tools renders it, we suppose, about as complete as one could desire, and makes it useful as a stock book for purchasers and users of engineering tools of these many kinds.

Calvert's Mechanical Almanac and Workshop Companion (4d.) with the 1900 edition reaches its 27th year of publication. It, as usual, contains a great deal of general reading matter which may be of use to many of those for whom it is written.

Messrs. Merryweather & Sons, Limited, the well-known fire engine makers and water engineers, send us a 1900 calendar.

Messrs. Holden & Brooke, Limited, of West Gorton, send circulars describing the "Sirius" steam trap and its advantages; also a very useful glass paper weight for the desk. We understand that the sales of the "Sirius" trap during the present winter already exceed those of any past season.

From Mr. Emil Passburg, of Berlin, we have received an illustrated list of his patent vacuum drying apparatus for cables, dynamos, motors, &c.

Messrs. Bayleys, Limited, of Newington Causeway, send us an illustrated list of their steam motor vans, showing a steam trolley and a dust van. Some general notes, together with remarks as to fuel consumption, are given.

The Scottish Provident Institution has issued its pocket diary and prospectus for 1900.

From the British Thomson-Houston Company we have received illustrated pamphlets as follows:—No. 50, polyphase induction motors; No. 51, G.E.-58 traction motor.

Change of Name.—The sanction of the Board of Trade to the change of name of the Brazilian Submarine Telegraph Company has been obtained. The name of the company will in future be the Western Telegraph Company, Limited.

Co-operative Consumers, Limited, v. Symmons and Co.—Last week at the Brighton County Court, plaintiffs claimed £2 5s. 2d. for goods supplied and expenses incurred by reason of the supply of "red" electric lamps, which, three months after being installed, turned "white." The judge held that a red lamp was one which remained red. If he bought a red hunting coat and it turned yellow, he would not expect to pay for it. Judgment for plaintiffs for £2 2s. 3d.

Downie v. Adams.—In the Queen's Bench Division last week an action was brought by Mr. Charles Manners Downie, of Bedwardine, Upper Norwood, against Mr. F. G. W. J. Adams, of 70, Balcombe Street, Dorset Square, N.W., for damages for libel. The libel complained of was contained in a letter written by the defendant to Messrs. Francis & Spilsbury, of 20, Bucklersbury, electrical engineers, dated April 27th, 1899. The defendant did not appear. Mr. Downie, the plaintiff, proved the defendant's signature to the letter, and Mr. Spilsbury the receipt of the letter.—Mr. Justice Wright, in summing up to the jury, said it was a most outrageous libel. The defendant pleaded in his defence that the statement was made in good faith and on a privileged occasion, but no privilege could excuse a libel such as that. He thought, although no special damage was proved, that they would be justified in giving substantial damages. They were entitled to give such damages as would show their opinion of the character of the libel.—The jury found a verdict for the plaintiff for £250 damages.

Electrical Engineering in Caucasia.—A contract has lately been secured by the Vereinigte Electricitäts Gesellschaft, of Vienna, for a complete electric lighting and power transmission plant for the ironworks of the Terek Mining Company at Alaghir, Caucasia.

Electrical Engineering in Germany.—The proprietor of the Berghaupten Collieries at Gengenbach (Baden) is credited with the intention of establishing a central power station, using the coal on the spot in the generation of electric energy for lighting and power purposes in the district.

Electrical Engineering in Italy.—After much negotiation the Società per L'Illuminazione Elettrica di Chiavenna has, under certain conditions, agreed to dispose of its rights in the water power of the River Liro to the Società delle Ferrovie Nord-Milano. The latter company intends to establish an electric power plant of 3,000 H.P., and to transmit the electrical energy generated to Como, whence it will be distributed for traction purposes as desired. One of the first lines on which electric traction is to be adopted is that between Chiavenna and Lecco.

Felten & Guilleaume.—A correspondent says that a joint stock company with a capital of £1,500,000 has just been formed to acquire and carry on the wire and electric cable business of Messrs. Felten & Guilleaume, of Mulheim-am-Ruhr-Germany.

Humber Defence.—Notice is given in the local press for the general information of mariners, that the War Department propose to work the electric light established at Paull battery for the defence of the Humber in connection with the Submarine Mining Service on every Wednesday from sunset to midnight between January 1st and March 31st next.

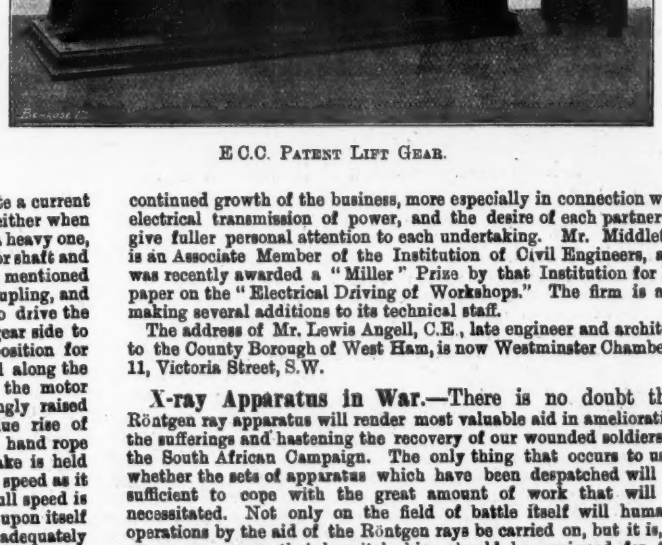
King's College.—The Lent term in engineering, architecture, and applied science commences on Thursday, January 18th. Particulars may be obtained from an advertisement in this issue.

Middlesbrough.—The North-Eastern Railway Company has placed orders with Messrs. Cowans, Sheldon & Co., Limited, of the St. Nicholas Works, Carlisle, for an electric installation for the new docks at Middlesbrough, which, it is said, will be the largest and most complete of its kind in the country. The order comprises three 10-ton and 17 3-ton electric cranes, besides electric capstans, &c.

Pyke, Harris & Co. v. The Gwynne Electrical Close Tube Company.—In the Westminster County Court on Tuesday, before his Honour Judge Lumley-Smith, Q.C., Messrs. Pyke, Harris and Co., Limited, of New Tothill Street, S.W., sought to recover £31 for making an electrical alternator for the defendants, the Gwynne

Electrical Close Tube Company, Limited. Mr. Andrews, who appeared for the plaintiffs, said the apparatus was made from a rough sketch by Messrs. Easton, Anderson & Co. and their charge was £28 4s. 6d. His clients charged a profit on that, but they would abandon that amount. Defendants had paid £15 into Court. He admitted that it was possible to make a machine like that for the amount, but then this had to be made from a rough sketch only. The cost book of Messrs. Easton showed that the labour amounted to £12 9s. 11d; the establishment charges £9 7s. 1d.; materials, £2 15s; establishment charges thereon 2s. 7d. The details of the claim were gone into at considerable length, and for the defence evidence was given that £15 was a fair price, that the work was rough, and some of the witnesses put the fair price of the thing at £4, as far as the labour was concerned. His Honour found for the plaintiffs for £25 3s. 6d., with costs.

E.C.C. Patent Lift Gear.—We illustrate a patent lift gear of novel design, recently introduced by the Electric Construction Company, Limited, for which it is claimed that failure of any part of the apparatus is unattended by danger, that nothing depends on the skill of the operator, and that a very high efficiency is attained. Two of these lifts have been erected as part of the electric installation at the new factory and warehouse of Messrs. Bovril, Limited, where they have been in successful operation for some time under very severe conditions, being in continual use all day under widely varying loads. The motor is of the E.C.C. enclosed ironclad type, and the weight of the empty lift is balanced by counterweights to the usual extent. If the load is such, in ascending or descending, that it overtakes and drives the motor above its proper speed, it acts as a brake by generating current and returning it to the supply mains. Should the supply mains at any time be incapable of absorbing power, provision is made to prevent over-running by applying a powerful friction brake through the action of a solenoid, the circuit of which is closed and opened by a centrifugal governor driven from the motor shaft. This brake consists of two arms which are held clear of the brake drum by means of an electro-magnet against the pull of a strong spiral spring. The coil of the magnet is in shunt across the mains, the circuit being made and broken along with the starting switch. The motor is connected by a claw coupling, having 90° play, to two right and left-hand worm gears, which take up the thrust, thus preventing loss of power by friction. Upon the axle of each worm wheel is mounted a pulley, round which the steel ropes run for supporting the cage and counterweights. The worm gear is completely enclosed in an oil bath, and will run for a considerable time without attention. An endless rope running through the cage actuates the starting and reversing switch shown on the right hand of the illustration. The motor is started up through a resistance, the cutting out of which is not under the control of the driver, but is performed automatically by the accelerating switch, which is mounted on the bed-plate. This switch is put into action by an oscillating lever driven by an eccentric from the motor shaft. The lever carries a pawl, which is actuated by a small magnet. When all the resistance is cut out the magnet is short-circuited and the switch bar ceases to move, although the lever still oscillates. The switch bar is retained by a brake band passing round a drum on the switch bar and operated by another small magnet, and on the circuit being broken the switch bar is automatically returned to the position in which all resistance is in, by the weight which can be seen in the illustration. The gear to enable the motor to generate a current with increase of speed when it is called on to act as a brake, either when the cage is ascending with a light load or descending with a heavy one, consists of a disc mounted upon a screwed portion of the motor shaft and driven by a pin fixed to the gear half of the coupling. As mentioned above, there is 90° of play between the halves of the coupling, and should there be a tendency on the part of the gearing to drive the motor it will be necessary for the half coupling on the gear side to travel through an angle of 90° before it comes into position for driving. In traversing this distance the disc will travel along the screwed shaft sufficiently to short-circuit a resistance in the motor field. The counter E.M.F. of the motor is correspondingly raised and a braking current generated which prevents undue rise of speed. On closing the starting switch, by means of the hand rope from the cage, the following action takes place:—The brake is held off and the motor starts slowly, gradually increasing the speed as it cuts out the resistance in circuit with the armature until full speed is attained. On switching off, the motor is short-circuited upon itself through a fixed resistance of such amount that the motor is adequately retarded, the friction brake is applied, and the switch bar returns to its position of "resistance in" in readiness for a fresh run. Trip switches are provided to the lift hatchway in case the cage should exceed the limits of its travel. These are arranged so that the switch bar is carried clear of the contacts by the cage and cannot be replaced in the contacts until the cage has been run back. When either of the trip switches is open the circuit is made by means of a switch placed in parallel with the trips. This switch is placed outside the hatchway and is in a locked box, so arranged that the cover cannot be shut down until the switch is open.



E.C.C. Patent Lift Gear.

Railway Station Lighting.—In reference to the paragraph under the above heading on page 974 of our last issue, we are informed that the arc lamps at Ludgate Hill and Holborn, London, Chatham & South-Eastern stations, are "Brockie-Pell's." Those at Snow Hill are of the Jandus make.

Rhodesia.—In the *British and South African Export Gazette* we read that the provision of an electric transmission plant, capable of driving a 20-stamp mill, with pumps, winding gear, and other accessories, at an estimated cost of £10,000, is under consideration by the directors of Rezende, Limited, for their properties in Eastern Rhodesia.

Smoke Nuisance.—The Guildford Council has decided to take action against the Electric Lighting Company for continued smoke nuisance. The engineer partly blames the fact that it is impossible to obtain Welsh coal at present because of the Government demand.

Sun Electrical Company.—At the showrooms of this company may be seen just now some pleasing novelties in electric fittings, which we understand are in process of being photographed for illustrating the catalogue which the company will have ready early in the new year. The Sun Electrical Company, who took over the business no longer ago than August last, have shown a determination to aim at a reputation for high class English-made goods, yet with a due consideration to the popular demand for a sterling article at a moderate price. Nor is the importance of prompt delivery lost sight of, ample stocks being kept. The company are wholesale agents for the Crystal Lamp Company, and are able to deliver immediately from stock on the premises. Mr. Collis, the courteous manager, is always pleased to show visitors round and answer inquiries.

To the Trade.—Mr. A. P. Lundberg's premises in Bradbury Street, Kingsland, were broken into on 17th inst. To all appearances the booty was very small, but as the letter box was tampered with Mr. Lundberg will be glad if those who have communicated with him, and have received no acknowledgment, will again write to him.

Trade Announcements.—Messrs. Christy Bros., of Chelmsford, announce that they have taken Mr. William Middleton, of Leeds, into partnership, and in future the name of the firm will be Christy Bros. & Middleton. This step has been taken owing to the continued growth of the business, more especially in connection with electrical transmission of power, and the desire of each partner to give fuller personal attention to each undertaking. Mr. Middleton is an Associate Member of the Institution of Civil Engineers, and was recently awarded a "Miller" Prize by that Institution for his paper on the "Electrical Driving of Workshops." The firm is also making several additions to its technical staff.

The address of Mr. Lewis Angell, C.E., late engineer and architect to the County Borough of West Ham, is now Westminster Chambers, 11, Victoria Street, S.W.

X-ray Apparatus in War.—There is no doubt that Röntgen ray apparatus will render most valuable aid in ameliorating the sufferings and hastening the recovery of our wounded soldiers in the South African Campaign. The only thing that occurs to us is whether the sets of apparatus which have been despatched will be sufficient to cope with the great amount of work that will be necessitated. Not only on the field of battle itself will humane operations by the aid of the Röntgen rays be carried on, but it is, of course, necessary that hospital ships should be equipped for the purpose. In the hospital ship, *Princess of Wales*, recently fitted out, this matter has been attended to, and a set of apparatus was specially designed and made for her by Messrs. Harry W. Cox & Co., Limited, of Cursitor Street.

ELECTRIC LIGHTING NOTES.

Aberavon.—At a meeting of the Town Council last week, Messrs. Lewis & Steinitz explained the objects of the Electrical Power Distribution Company, Limited, with regard to their proposed

application to the Board of Trade for powers to supply Aberavon with electricity. It was decided to take joint action with other South Wales boroughs to oppose the scheme, as the company could give no guarantee to limit its supply to motive power only.

Auckland.—A special meeting of the Auckland Urban Council was held last week to consider the application of two companies which are applying to the Local Government Board for powers to light the town by electricity. It was unanimously decided to support the application of the Urban Electric Lighting Company, Limited.

Austria.—A large central station has just been completed at Soborten, near Teplitz, by Messrs. Kummer & Co., of Dresden, for the supply of electrical energy for lighting and power purposes to a large number of small towns in the district.

Battersea.—The vestry clerk is communicating with municipal electric supply works as to the powers of local authorities in regard to the wiring of private premises without requiring direct payment for the work, on the system adopted by the London gas companies in the case of the automatic slot meters and fittings.

Bournemouth.—Colonel C. H. Luard, R.E., one of the inspectors of the Local Government Board, held an inquiry on Thursday last week into the application of the Town Council to borrow £1,750 for purposes of electric lighting.

Broken Hill (N.S.W.).—The Corporation is about to undertake the supply of electricity for public and private lighting at an initial cost of £12,000.

Canterbury.—The Town Council has resolved to adopt the maximum demand system, at 7d. per unit for the first 100 hours' use per quarter of the maximum demand, and 3d. afterwards, to date from April 1st, 1900.

Cardiff.—A motion was to come before Monday's Council meeting thus:—

That this Council, viewing with alarm the proposals of the South Wales Electricity Power Distributing Company as contained in its Parliamentary Bill, considers the granting of such powers highly prejudicial to the development of the Cardiff electricity works in regard to the supply of electric current for lighting and power purposes. It is resolved (1) that negotiations with the district authorities contained within a radius of 20 miles of Cardiff be opened with a view to the erection of a joint electric power station on a convenient site in the Pontypridd coalfields. (2) That among other purposes, such power station shall supply all current necessary for the working of the electric tramways which have been proposed and sanctioned.

Hackney.—The Electric Lighting Committee is considering the tenders received for the erection of dust destructors in connection with the electricity works.

Hastings.—The Town Council has resolved to reduce the charge for electricity supply from 8d. to 6d. per unit, with special terms to long-period consumers.

Hoylake and West Kirby.—An inquiry was held last week, on behalf of the Local Government Board, into an application by the Hoylake and West Kirby District Council to borrow £27,000 for the purposes of electric lighting.

Ilford.—A Local Government Board inquiry is to be held to-day into the Council's application for leave to borrow £68,500 for tramways and electric lighting purposes.

Keighley.—The Gas and Electricity Committee of the Keighley Corporation recommends that application be made to the Local Government Board for sanction to borrow £45,000 for electric lighting purposes.

London.—Further letters have appeared in the *Times* with reference to the Metropolitan Electric Supply Company. We abstract them as follows:—

"Yesterday, the 12th inst., the shops on the north side of Oxford Street, from Vere Street to the Marble Arch, were plunged in darkness. If the shopkeepers will combine, the remedy is in their own hands. The excuse of the scarcity of Welsh coal is a fallacious one. Railway communication between London and other towns has not been interrupted, nor have the big steamships ceased to ply between England and other countries. The consumption of coal on the *Campania* must far exceed that of a dynamo. If the Metropolitan Electric Supply Company has not made due provision, that company, and not its customers, should suffer. There is but one real remedy, that of a competing supply.

"Alfred L. Cohen.

"36, Gloucester Square, W., *December 13th.*"

"Permit me, as chairman of a committee of Marylebone tradesmen who are trying to obtain some redress in regard to the want of electric supply, to say that the trade consumers are not supplied with energy in preference to private customers. We have been sufferers in a much greater proportion, inasmuch as our light has been wanting for two months or more at the only time we require it for business purposes, that is between the hours of 4 and 8 p.m., and this has entailed a very serious loss.

"Charles R. Wood.

"21, High Street, Manchester Square,
"December 14th."

"Your correspondents who urge that the local Vestry should be invited to undertake the supply of electric energy throughout the area at present supplied by the Metropolitan Electrical Company, in order that a better service should be afforded, seem to ignore the fact that local authorities are just as much liable as companies to the difficulties that are apt to occur in the early stages of all new and growing enterprises.

"To take two leading examples. The electrical supply both at Edinburgh and at Manchester is entirely in municipal hands, but those acquainted with the service given in these important cities not so very long ago are well aware that for a considerable period the supply was in both instances exceedingly defective, for causes which, as I understand, were much the same as are at present giving trouble in the case of the metropolitan service.

"Municipalisation is, in fact, no panacea.

"A. A. Campbell Swinton.

"66, Victoria Street, S.W.,
"December 12th."

"Mr. Wood's grievance is even greater than he indicates, since his side of High Street has been left without light while the shops on the opposite side of that street have been fully lighted! It is the misfortune of Mr. Wood, apparently, that he happens to be on the same circuit as Wimpole Street and Harley Street; but these facts illustrate the preferential treatment. Montagu Square, *e.g.*, which is west of High Street, is said to have been lighted continuously until quite recently.

"Zetetes.

"December 16th."

At the meeting of the Paddington Vestry on 13th inst. the matter was discussed. Consumers were said to be "suffering most intolerably," and to be subjected to "absolutely monstrous" treatment. Sir E. Galsworthy blamed the company for taking on new consumers before they had increased the machinery to keep up the supply.

Dr. Little said the Harley Street fraternity were much inconvenienced. Two medical men had informed him that they were in the midst of a dental operation when the light went out.

Mr. J. Lewis spoke of the inconvenience and loss of business at his shops in Oxford Street. Several hundred candles had to be used. It also meant a loss to the employés.

Mr. Stringer said the Parliamentary Committee had decided that they must have indicators fixed up at the Court house and connected with the various mains in the parish. This would be done under the agreement at the expense of the company. They must also have an electrical inspector to take the readings of the indicators as to the current supplied. The Committee had decided to appoint an inspector, and had called on the company to fix the indicators at once.

Mr. White, L.C.C., said it would only be a temporary appointment.

The Vestry approved of the Committee's action.

The Chairman observed that it was little short of a scandal. If they had been able to make complaints to the Board of Trade and Parliament, there was not the least doubt that Parliament would have given the Vestry a competing order against the company.

Whilst the Chairman was making these remarks, the electric light failed in the board room, and remained out for half an hour.

On the motion of Mr. White, L.C.C., seconded by Mr. Stringer, the clerk was instructed to apply for a summons on behalf of the Vestry as consumers against the company for the 40s. penalty in default of non-supply. The letters received were referred to the Committee. It was also decided to have distributed a number of circulars giving abstracts from the Act showing the company's liability.

Manchester.—The Electricity Committee of the Manchester City Council has come to terms with the Midland Railway Company for the supply of the whole of the electricity required for power and light in the Midland Grand Hotel, in Peter Street, from the Corporation station. The installation in this colossal building will be exceptionally important, and it is estimated that the consumption of electrical energy will cost somewhere about £10,000 a year. Two years at least must elapse before the equipment is completed.

Newport (Mon.).—The Electricity Committee has decided, on the recommendation of the electrical engineer, to connect the condenser to the 3-inch water main, so that in case of emergency the Corporation water can be used for condensing. The total number of lamps connected and on order is equal to 31,540 8-c.p. Proper office accommodation for the electricity department is said to be seriously needed. There is available space alongside the existing station which might be used as a site for the tramways power station. This is under consideration. A deputation from the Lighting and Traffic Committee has been visiting electric tramways and power stations in other towns. The solicitors of the Zipernowski Patent Transformer Defence Fund have made another call for £9 odd towards the cost of defending the action brought by Mr. Martin Rucker against the London Electric Supply Corporation, and this sum has been paid.

Oban.—A scheme is on foot for supplying electricity in Oban from a municipal station.

Oswestry.—M. R. H. Bicknell, on behalf of the Local Government Board, last week concluded an inquiry respecting the application of the Oswestry Town Council for sanction to a loan of £18,000 for the purpose of completing the purchase of the Oswestry Electric Light and Power Company's undertaking, and carrying out the same. A number of ratepayers opposed the application.

Perth.—The Electric Lighting Committee has passed plans by the burgh surveyor of the electric light station which is to be erected at the Shore.

Poplar.—The Council is applying to the London County Council for a loan of the additional money required for the electricity buildings. Since the surveyor's estimate in 1898, there has been an increase of 15 per cent. (£1,438) in the price of materials; then there are alterations and additions to the offices and buildings, which necessitate expenditure beyond the original estimate, bringing up the total of the present application to £4,370.

Portsmouth.—At a meeting of the Town Council on Tuesday a report from the Electric Lighting Committee was adopted, recommending that an offer of £750 be made for the purchase of property in Crown Street, Portsmouth, adjoining the electric lighting works, and that a formal offer of £700 be made to owners of other property adjoining the works, and that the necessary notices be given to the said owners of the intention of the Corporation to summon a jury to decide the price to be paid if an arrangement can be made. Electric light mains are to be extended along a number of roads.

Queenstown.—The Cork Electric Lighting Company have secured the contract for illuminating the town of Queenstown by electricity.

Rhyl.—The District Council has resolved that application be made to the Local Government Board for sanction to borrow £15,250 for the purposes of electric lighting, and £4,750 for a refuse destructor, and that Messrs. Trentham & Peers, electrical engineers, be engaged to prepare the necessary plans and documents. Applications have already been received for 1,100 lamps.

Ruislip.—The Northwood Electric Lighting Company and the Uxbridge Syndicate seem to be vieing with one another for permission to supply the electric light. Fifty persons petitioned the Parish Council in favour of the Northwood Company.

St. Helens.—The Town Council has resolved to apply to the Local Government Board for leave to borrow £20,000 for extensions of the lighting plant, and £25,000 for additional equipment for the tramways.

Salford.—An inquiry was held at the Salford Town Hall last week by Mr. W. A. Ducat, inspector of the Local Government Board, in regard to the application of the County Borough Council for sanction to borrow the sum of £398,683 for purposes of electric lighting and supply. The town clerk (Mr. L. C. Evans) stated that the population of Salford at the census of 1891 was 198,139, and in the present year it was estimated by the Registrar General at 218,244. By an order of 1890 the Corporation were authorised to supply electrical energy in the borough, and with the sanction of the Local Government Board they had already borrowed sums of money for carrying out their powers. The Corporation had established a generating station at Wallness Road, which was on the alternating system, but the demand for current had increased so rapidly during the last 12 months that the station was quite unable to cope with it, and after long consideration and the inspection of various sites the Corporation had purchased a plot of land which abutted on Strawberry Road, Pendleton, and plans and estimates had been prepared for the construction of buildings. The figure of £398,683 was divided into three parts—£50,000 for the erection of the requisite buildings; £335,783 for the whole of the machinery and plant and the underground and overhead distributing mains in connection with the station; £12,900 for the extension of the low and high tension cables connected with the existing station at Wallness Road. The lease of the tramways granted by the Corporation expires in 1901, and they had determined on its expiration to work the tramways themselves by the overhead system of electric traction. He urged the necessity of obtaining the sanction of the Local Government Board in order that they might proceed with the work in preparation for taking the tramways over. Mr. S. V. Clirehugh, consulting engineer, and Mr. C. L. Turner, resident electrical engineer, supplied the inspector with the necessary details, and Mr. A. Haworth, chairman of the Electric Lighting Committee, stated the reason for asking the Local Government Board's early sanction to the present application. There was no opposition.

Shildon.—At a meeting of the Urban Council it was unanimously decided not to proceed with the application for a provisional order for electric lighting this year. A committee was appointed to consider the whole question.

Shoreditch.—Plans for the construction of a new electric lighting sub-station at the junction of Great Cambridge Street and Hackney Road (cost £1,500) have been passed by the Vestry. Two additional motor transformers are to be purchased for the Worship Street and Great Eastern Street sub-stations.

South Shields.—Last week a Local Government Board inquiry was held with respect to the application of the Town Council to borrow £15,600 for electric lighting purposes, and the details of the scheme were explained by the town clerk and Mr. Jeckell, the electrical engineer. The money is required for additional electrical plant to meet the growing demand in the town for the electric light.

Smethwick.—At a meeting of the Town Council last week the Public Works Committee reported that, notice having been given by the Midland Electric Corporation for Power Distribution, Limited, of their intention to apply in the next Session of Parliament for an order empowering them to supply electricity for all public and private purposes in the borough of Smethwick, the Committee recommended that the town clerk be instructed to oppose the application and the granting of the proposed order. The directors of the Electric Corporation being desirous of interviewing the Committee upon the question, the Committee had expressed their willingness to receive them at their meeting on January 2nd. The report was adopted by the Council

Southend.—The Light Railways and Electric Lighting Committee recommended the Council to rescind the motion under which they agreed to hand over the powers of the Southend Electric Lighting Order to Mr. A. H. Gibbings, of Bradford, and also recommended that the Committee be instructed to carry out the powers of the order with respect to electric lighting concurrently with the light railways. It was explained that Mr. Gibbings wished the Corporation to enter into an agreement, the terms of which were in excess of those previously agreed to. Accepting the recommendation of the Committee, the Council has now changed its mind, we trust finally, regarding the question of electric lighting, and has resolved to carry out the order itself. The lighting scheme is combined with electric tramways, the total outlay being put down at £115,000 (electric lighting, £35,000; and tramways, including permanent way, £80,000). Mr. J. B. Mitchell, who has occupied the position of borough electrical engineer for some time past, will now, perhaps, be able to get forward with work which will show for itself. His position, we should imagine, has not been altogether a bed of roses recently. Presumably, the Council will shortly be in the market for tenders for the respective sections of the contracts.

Sowerby Bridge.—At a special meeting of the Council on Thursday last, the question of the electric lighting order was fully discussed, and it was decided to go forward with the same. Mr. W. Emmott, who is the consulting engineer retained by the Council, gave a report on the lighting of the district with the aid of a refuse destructor and electricity generating station combined, and gave full details of the scheme, and its probable cost. He also furnished particulars of a scheme to be worked without a refuse destructor, on the present gasworks site, and fed from what is practically gasworks refuse.

Stamford.—The Town Council has come to terms with Edmundson's Electricity Corporation, Limited, and will support their application for a provisional order.

Sudbury.—The Town Council have resolved to apply for a provisional order under the Electric Lighting Acts, 1882 and 1888.

Swansea.—The Electric Lighting Committee recommends that the scheme of the South Wales Electrical Power Company be opposed, as it might come into Swansea and supply electric light in competition with the Corporation.

Twickenham.—The District Council last week decided to oppose the application of the Teddington and Twickenham Electric Lighting Company (Richmond) for electricity supply powers, to drop its own application, and to support that of Edmundson's Electricity Corporation, Limited. When Edmundson's have done the work it will be taken over by a company to be called the Twickenham and Teddington Electric Supply Company, Limited.

Wellingboro'.—The Urban District Council has adopted the recommendation of the Lighting Committee to apply for leave to borrow £3,500 for carrying out the electricity works.

Wingate.—The contract for supplying electric light to the mining village of Wingate has been completed. A dynamo, capable of providing for 600 lamps, has been put down, and 43 lamps of 25 c.p. have been placed about the village. The underground workings of Wingate Grange Colliery have also been lighted by the same means, and arc and incandescent lamps are to be provided for the heapstead.

Yiewsley.—In reply to a communication from the Uxbridge District Council, the Yiewsley Parish Council has requested the former to oppose the application of the Uxbridge and District Electric Lighting Syndicate for powers to supply the parish with electricity.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The overhead electric wire system on the Woodside tramway route was inspected on 15th inst. by Mr. Trotter, of the Board of Trade, and found satisfactory. The permanent way inspection was to follow a few days later. The public inauguration was to take place on Wednesday.

Barrow.—The British Electric Traction Company having taken over the Barrow steam trams, it is proposed to completely reorganise the system, electricity on the trolley system being substituted as the motive power. It is likely that the company will obtain power from the public supply works if satisfactory arrangements can be made.

Belfast.—The Corporation and the tramways company have again been unable to come to terms as to the proposed purchase of the company's undertaking, and negotiations are now stated to have been broken off.

Bradford.—The Tramways Committee proposes to set aside 5 per cent. of the gross receipts and the income from advertising on the electric tramcars for an insurance fund against accidents.

(*Continued on page* 1011.)

AN ELECTRICAL QUARRY INSTALLATION.

In no case, perhaps, are the advantages and economies of electrical driving brought into evidence more clearly than in that of the electrical transmission of power in quarries; more especially is this so in the case of the quarry we are about to describe, which is in a mountainous district in the Lowlands of Scotland, where the nearest coal siding is two miles away from the quarry working. In this instance we have not only the economy of electric motors as compared with the highly inefficient steam crane, practically blowing off steam continuously, but also the facility of electric transmission of power from the railway siding to the centre of the workings.

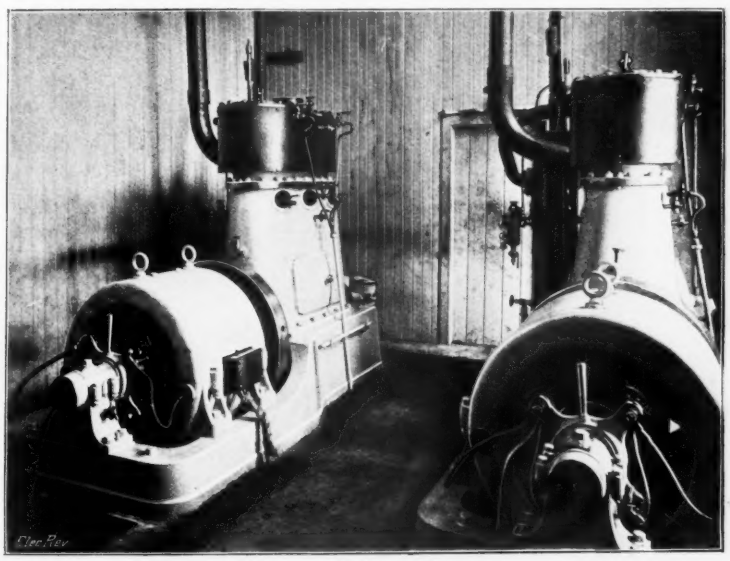


Fig. 1.

These quarries are situated about 6 miles from Dumfries; the generating station is at Closeburn, also about 6 miles from Dumfries, on the main line of the Glasgow and South-Western Railway. The generating plant consists of two 80-H P. direct-coupled sets. The dynamos were made by Messrs. D. Bruce Peebles & Co., Edinburgh, of their patent "P.P.P." traction type. The field magnet cores and poles are of annealed cast-steel, with patent cast-iron pole-tips; the function of the latter is to provide a constant magnetic fringe independent of the main field, in order to ensure sparkless commutation with fixed lead at all loads, a most important point for the very varying load which is such a feature of quarry work. The engines are by Messrs. Mirrlees, Watson and Yaryan Company, Glasgow, of their compound single-acting type, with piston valve between the high and low pressure cylinders. A view of the engine house is shown in fig. 1,

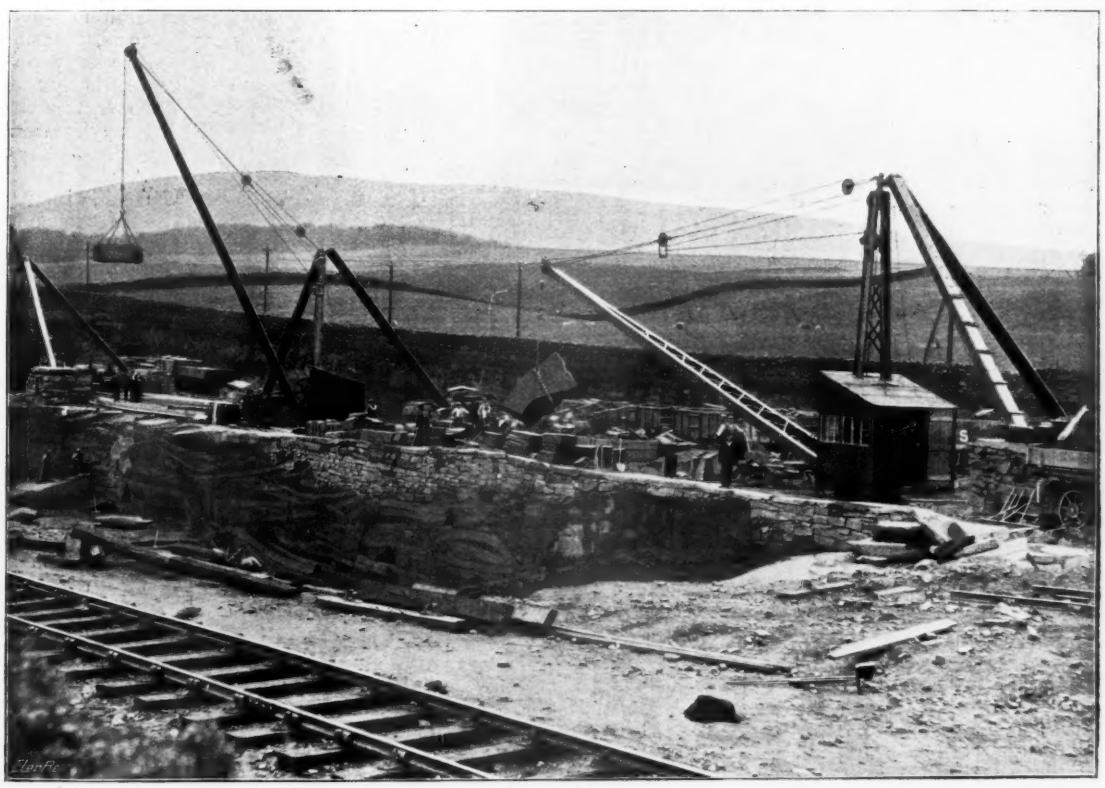


Fig. 4.

and of the switchboard in fig. 2. The generators are protected by automatic circuit breakers. The current, at a

pressure of 500 volts, is carried for a distance of two miles along the railway track, as shown in fig. 3, where it will be seen that the line is overhead to the quarry workings, a view of which is given in fig. 4. The line was erected under the supervision of Mr. H. Agnew, resident engineer to the quarries, of which Mr. Thos. Lamb is manager.

At the quarry there are seven 10-ton derrick cranes at work, each driven by a 15-B H.P. Peebles patent "P.P.P." motor of the completely enclosed type. The motor is geared direct to the crab by means of a rawhide pinion, gearing into double reduction gear on the crane barrel, as shown in fig. 5; the ratio of the speed of the motor to that of the first shaft is 1 : 4·5.

The motions of the crane are operated by means of a patent reversing controller, as shown in fig. 6. This controller can be worked by the most inexperienced labourer or navvy, and is made as mechanically perfect and as strong as is possible. It is a most important point in crane work that the controller should be as strong and as rigid as it can be, and Messrs. Bruce Peebles & Co. have taken great pains in the design of their crane reversing and controlling switch to make simplicity and mechanical rigidity the main features of its construction.

As seen in the figure, the handle is in the middle position; a movement of the same through an arc of 45° sends the contact arm round by means of gearing through 180° in one direction, while moving the handle

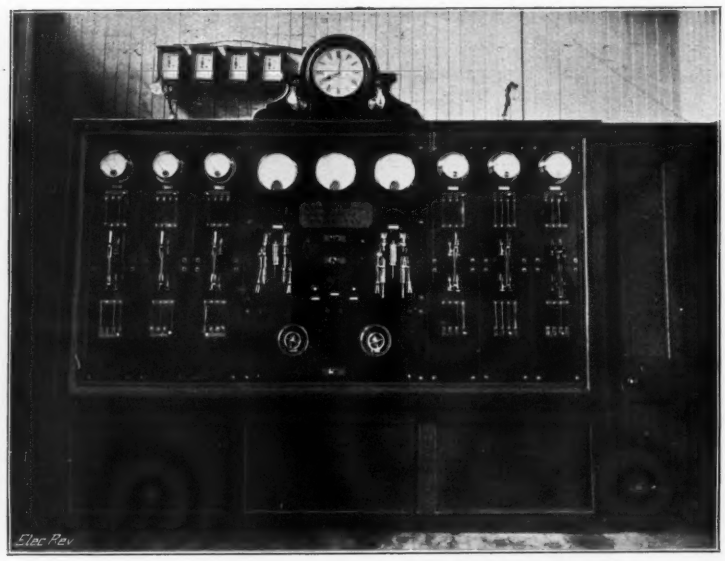


Fig. 2.

Fig. 3.

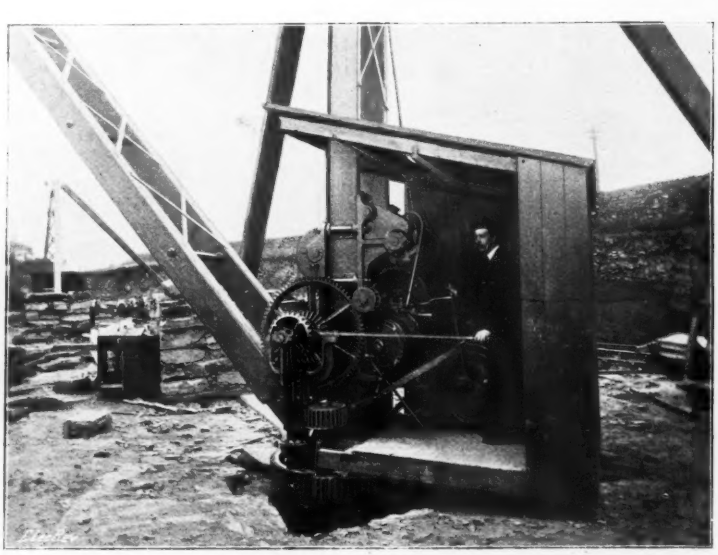


Fig. 7.

45° in the other direction sends the arm round 180° in the opposite sense, so that a very small movement of the radial arm implies a very large movement on the part of the switch. The contact blocks are removable, and have ample contact surface throughout. The makers state that this type of switch has given the utmost satisfaction wherever it has been used. A view is given in fig. 7 of the motor and controller in position on the derrick.

It is needless to point out how small and compact this arrangement is when compared with the ordinary donkey engine and its attendant coal bunker; and when it is remembered that these small engines are practically blowing off steam all day long, despite the fact that they are only worked for certainly not more than one-tenth of the working hours, the enormous superiority of an electric system of power transmission is very evident.

Fig. 5 shows the Peebles motor in detail, with its raw hide pinion, ready for erecting in position. The main points aimed at in the design of this machine for crane work are compactness and ability to start under excessive torque. The motor will readily take 25 H.P. without sparking. A point to be borne in mind when designing crane motors is that the electrical efficiency measured on the basis of the ordinary rating should be secondary to the ability of the motor to cope with varying loads and to be absolutely sparkless up to 50 per cent. overload.

A series wound crane motor should not be built on the same lines as an

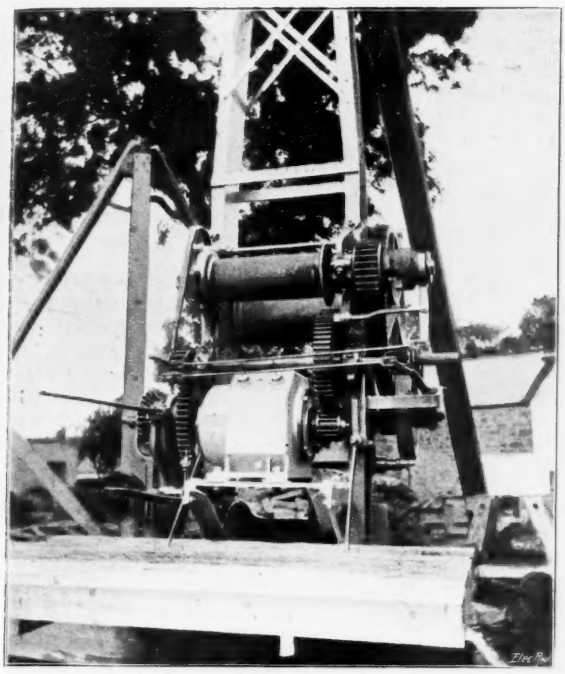


Fig. 5.

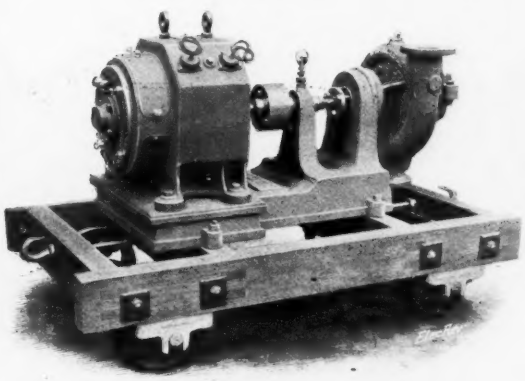


Fig. 10.

ordinary motor for continuous running, but should be designed in the same way as the standard traction motor, to withstand severe overloads and to be as mechanically sound as possible.

The Peebles motor has been specially designed with this end in view, and from its compact construction is admirably suited for work of this description.

Electric power is also utilised in the stone planing and cutting shops situated close by the generating station, where three 15 B.H.P. motors and three 10-B.H.P. motors drive respectively by means of gearing the reciprocating stone planers and sawing machines. Fig. 8 shows a Peebles "P.P.P." protected motor driving the gearing for a reciprocating saw; a similar motor driving a planing machine is seen in fig. 9. The rough stone from the quarry is here machined, before being placed in the railway trucks at the siding.

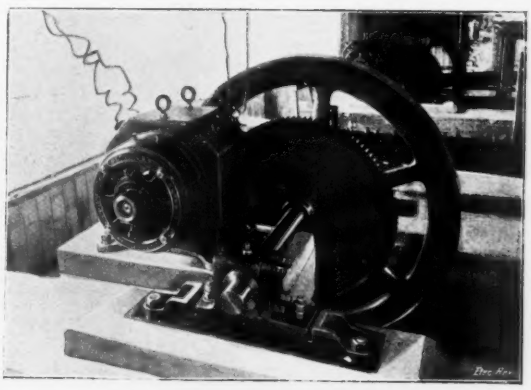


Fig. 8.

Fig. 9.

In fig. 10 is seen Messrs. Peebles & Co.'s standard combined centrifugal pump and motor, which is mounted on a movable trolley; several of these sets are employed in quarries for draining the workings, and are exceedingly convenient for this purpose, the power being transmitted by means of a flexible cable.

As regards the working of the plant, there are altogether seven cranes installed, each of which takes from 15 to 20 B.H.P. as a maximum, and the average load factor for the cranes alone may be set down at about 20 per cent. The same plant, however, which drives the cranes also drives

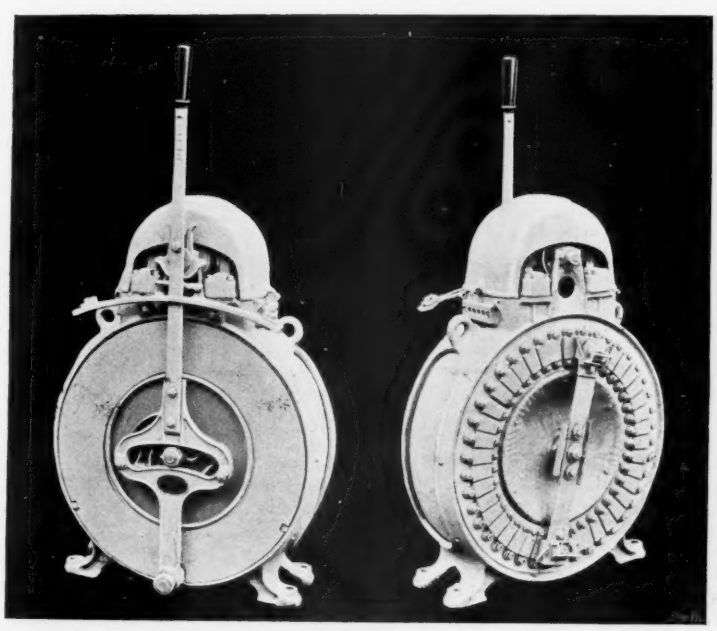


Fig. 6.

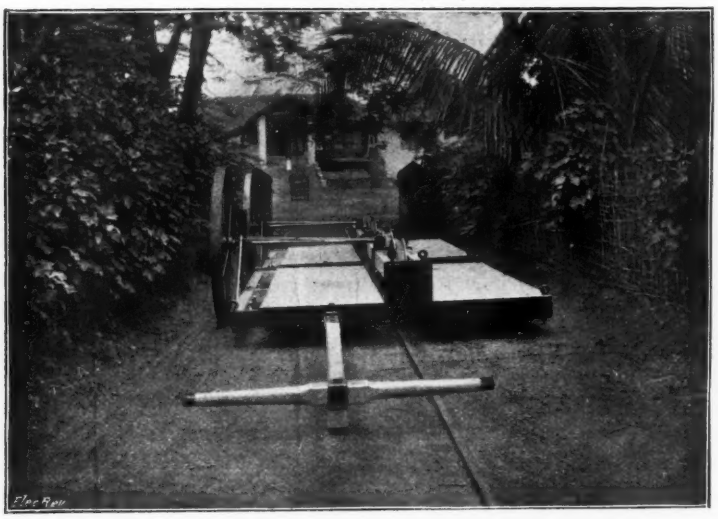


Fig. 1.

the stone cutting and planing machines, the average demand of which is 40 H.P., with a load factor of about 50 per cent., so the whole plant could be normally run by working one 80-H.P. set at its full load, or the two running half load, so that if absolutely necessary either machine could act as a spare on the other.

As, however, the maximum load is *momentarily* as much as 140 H.P., it is advisable to run the two sets always. The average drop on the line is 5 per cent.; the line has to transmit the power to the crane motors only.

The monthly coal consumption for the whole installation, consisting of seven 15-H.P. crane motors, three 15-H.P. planing motors, three 10-H.P. saw motors, and a steam hammer and pulsometer, the latter two taking about 15 H.P. for an average of about four hours a day, works out at about 90 tons a month at 7s. 6d. per ton; this is working non-condensing and with cold boiler feed. Condensers are, however, being installed, and it is anticipated that when this alteration is made the consumption will not exceed 65 tons a month, which is about one-third of the coal consumption were the whole installation driven by steam. When the pulsometer and steam hammer are replaced by electrically-driven machinery, it is confidently expected that the comparison will be still more favourable to electrical working.

EWING'S SINGLE-RAIL TRAMWAY.

The accompanying figures illustrate the single-rail tramway invented by Mr. Charles Ewing, whose letter will be found in our "Correspondence" columns. The special advantages claimed for this system are simplicity, cheapness, speed of construction, and small tractional resistance.

Quoting from a paper read before the United Service Institution of India by Lieut.-Col. F. F. R. Burgess, I.S.C.:—

"On a level road one pair of bullocks can, on a single line, draw a train of trucks, carrying a net load of from 6 to 7 tons, a distance of 15 miles in a day with ease; it requires from 16 to 18 pairs of bullocks to draw this load in ordinary carts carrying the military regulation 800 lbs. load.

"The trucks run on a single line of rail laid on the ground or roadway, and are mounted on two or three double-flanged wheels placed under their centre. These wheels are of small diameter, varying from 15 to 30 inches, according to the size and weight of the trucks and rails, the flanges being twice as far apart as the width of the head of the rail on which the wheels run.

"The whole weight of the truck is thus borne on two or three double flanged wheels which run on the single rail, so that, unless it were supported in some way, it must fall over. The necessary

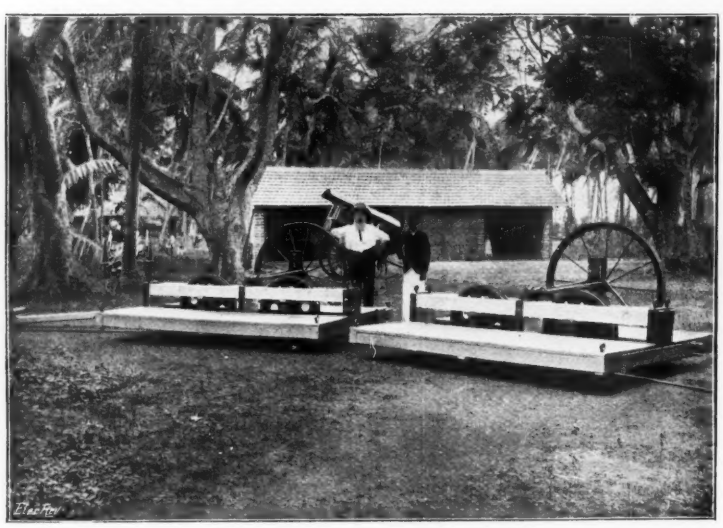


Fig. 2.

Fig. 3.

support is afforded by a lightly constructed iron 'balance' wheel of comparatively large diameter, from 4 to 5 feet, with a 4-inch wide tyre, placed at the side of the truck.

"This balance wheel runs on the surface of the ground or roadway about 4½ or 5 feet away from the rail. It runs on an axle which is pivoted at right angles to the centre of the truck and is kept in position by a hornplate fixed to the frame of the truck. The axle is also furnished with a double helical spring which eases the jolting of the balance wheel when going over any inequalities. The platform of the truck, which carries the load, extends to an equal distance on each side of the central line of the truck over the rail and flanged wheels, and the load would usually be evenly distributed on it, but should it not be so, there would be no risk of the truck upsetting, as the balance wheel provides

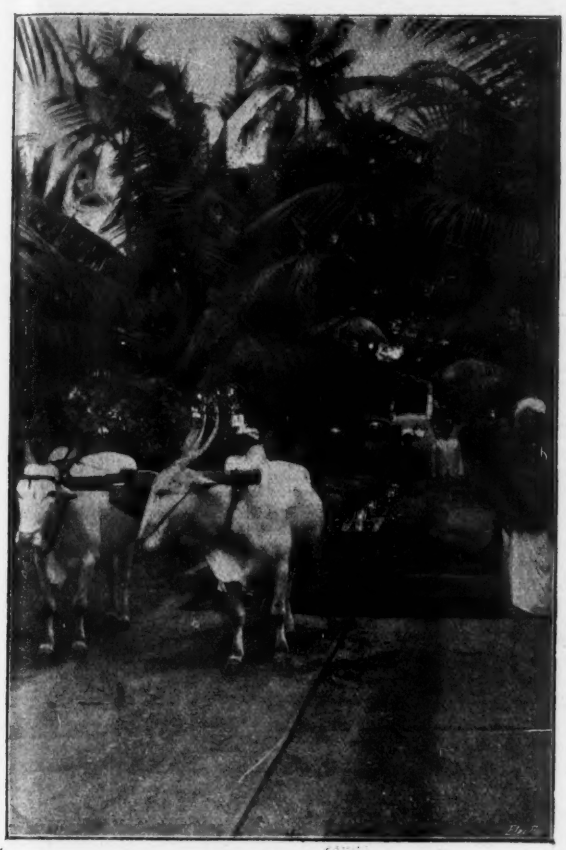


Fig. 4.

against this, and an excess of several hundredweight may be placed on the far side, away from the balance wheel, without risk. This is due to the fact that the balance wheel is placed at a considerable distance away from the side of the truck, generally 5 feet from the centre of the light 1-ton truck, which has a 6-foot wide platform, and the leverage thus afforded enables a light balance wheel of only about 160 lbs. weight to balance more than three times its own weight of excess load on the far side and thus allow for careless loading, &c.

"The balance wheel does not bear any of the weight of the load on the truck, and but a very small proportion of the weight of the truck itself, and, therefore, causes very little loss of power through frictional resistance, especially on a smooth surface.

"The axle of the balance wheel may either be straight or cranked; in the latter case it goes under the platform of the truck, leaving it perfectly flush and clear for the load, which is an advantage; but for certain purposes it may be better to have the other pattern, which allows of the centre of gravity being considerably lowered, as the platform can be made very low, only 8 inches above the road surface, if required.

"The truck runs very smoothly, and requires very little force to start it on level ground. It is strongly but lightly constructed of teak or other suitable wood, and is fastened with iron nuts and bolts. It is very light in proportion to the load it is intended to carry, which itself is only limited by the weight of the rail and the description of rolling stock carrying it."

Fig. 1 is a front view and fig. 2 a side view of a pair of empty trucks to carry 3½ tons each; fig. 4 shows similar trucks loaded, and drawn by a pair of bullocks. In fig. 3 the train is seen going round a curve of very short radius.

"The rails used on this system are of the ordinary railway description, and their size and weight vary according to the work required; for instance, in the light planter's line on this system, such as that on Messrs. Finlay, Muir & Co.'s estates in the Travancore Hills, some 22 miles in length, the rail used weighs only 14 lbs. to the yard, the two-wheel trucks running on it carrying loads of 1 ton each, this light rail being only intended to bear the gross weight of three-quarters of a ton per wheel; but where heavier loads are required to be carried on larger and heavier trucks, a heavier rail would be necessary.

"Single line rails for ordinary use on existing roads are laid on small wooden sleepers to which they are spiked in the usual manner. These sleepers are 18 inches long, 8 inches wide and 3 or 4 inches thick."

There is no keeping the rails in gauge as in a double line, and it does not matter if the rails shift a little, a serious matter with a double line; the cars can be run with ease round curves of 25 feet radius, or even less.

To enable trains of cars to pass each other, each truck carries a ramp fitting the head of the rail, attached to a single rail; when two trains meet, these spare rails are used to make a temporary siding, on which one of the trains is run.

Bullocks are generally employed for haulage; but two men can easily propel a truck carrying a load of 1 ton at a walking pace. Various passenger cars, ambulances, &c., have been designed for use on this system.

The application of electric haulage to a line of this description appears to present no difficulties. A light trolley line carried on wooden brackets, and locomotives of similar design to the trucks, would afford a cheap equipment suitable for light traffic on either a temporary or a permanent line. Working on the principle of small loads at frequent intervals, electricity would be at its best, and would compete favourably with any other mode of haulage.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 1006.)

The Cinque Ports.—The Deal Council briefly considered the Cinque Ports light electric railway scheme last week, but could not make up its mind whether to approve it or not, and eventually the matter stood adjourned. There are a number of very narrow thoroughfares through which the lines would run.

The Sandwich Council has agreed to approve the scheme conditionally. The matter was also brought before the Rye Council. Mr. Mark Parker, engineer for the scheme, explained the system to be established between Ramsgate and Hastings. It is intended to have a generating station at Sandwich to supply the electric current for motive power from Ramsgate to Dover, the Corporation's supply and lines being utilised at the latter town, and a large station at Rye to supply the power from Dover to Hastings. He emphasised the company's desire to appoint local directors throughout the route. The Council referred the matter to their Railway Committee for consideration.

Darlington.—Mr. J. Clifton Robinson, the managing director of the Imperial Tramways Company, and Mr. Barnley, the local solicitor, appeared before the General Purposes Committee on 12th inst. regarding the proposal to drop for the time being 4½ miles of the scheme. It was explained that the company meant to carry out the work as soon as the public requirements demand that they should be laid down. They asked the Council to agree to only 4½ miles being laid down now, and that the remaining 4½ miles should be constructed in two portions at periods of five and seven years respectively. This matter was again fully discussed, as was also the question of the supply of current by the Corporation to the company. The question was again adjourned.

Durban.—The Town Council has recently been in the market for trolley poles, rails, crossings, &c., for electric tramways.

Electric Railways.—It is quite possible, says the *Financial Times*, that the pending experiments with electric traction on a short section of the Metropolitan and District Railways may be successful from an operating standpoint, but only on the conclusion of the trials will it be feasible to form some idea of the financial prospects of the undertakings if steam locomotion were abandoned and electricity substituted as the motive power. In the meantime it is interesting to observe that the same problem, affecting two similar railways, has been raised in Berlin, although the experimental stage has not yet been reached in that city. The two lines concerned are the Berlin Metropolitan Railway and the Berlin Circle Railway, both of which are at present worked by steam locomotives and are hampered in dealing with the increasing traffic requirements. The Union Electricitäts Gesellschaft now suggests that by the substitution of electric for steam traction it will not only be possible to more easily handle the present traffic, but also that the alteration would increase the carrying capacity by no less than 260 per cent. It is claimed that this result would be accomplished by the adoption of trains each composed of eight motor cars (thus dispensing with an electric locomotive) and having a total passenger accommodation greater by 80 per cent. than that afforded by the existing type of steam train consisting of locomotive and nine coaches; and, further, by the running of the trains at intervals of two minutes instead of three minutes as prevails at present. According to the financial details worked out by the promoters of the scheme, the conversion of a large section of the two railways to the electric system would result in an economy in working expenses of 28 per cent as compared with the cost of steam-power. This result is arrived at after adding to the invested capital of £55,000,000, the sum of £9,150,000, which is the estimated cost of converting the particular section to the electric system. It is calculated that the receipts would readily allow of the payment of interest on the total capital outlay (£57,150,000) and also provide for redemption, and that with an extension of electric traction throughout the whole system the economy over steam locomotion would become greater than that already mentioned.

France.—The Paris, Lyons and Mediterranean Railway Company, of Paris, have just placed a contract for the establishment of a central power station to supply the electrical energy necessary for the electric railway between Chamounix and the Swiss frontier.

Glasgow.—The Tramways Committee received a deputation the other day, which brought forward the necessity that exists for electric trams in Alexandra Parade.

Gravesend.—The Drake & Gorham Electric Power and Traction Company have acquired the Gravesend tramway for the sum of £7,500.

Huddersfield.—A ratepayers' meeting last week approved of the Corporation Bill for reconstruction and extension of the tramways and electrical working.

Hyde and Stockport.—The Hyde Town Council held a special meeting on Monday night to consider proposals for a joint scheme of municipal electric tramways between Hyde and Stockport. The Electricity Committees of the two Corporations had previously met and decided upon terms, which, subject to a few alterations, have now been approved by the Hyde Council. It is proposed that in Session 1901 the Hyde Corporation shall apply for and obtain a provisional order for the construction of a tramway commencing at the borough boundary in Hyde Road, Bredbury, and terminating near the existing terminus of the Oldham, Ashton, and Hyde electric tramway at Gee Cross; such line to be constructed by and at the expense of the Hyde Corporation. Immediately upon the completion of the tramway the Hyde Corporation to grant, and the Stockport Corporation to take, a lease of it for 21 years, upon specified terms. By this scheme Stockport borough, the Urban District of Bredbury, and the Borough of Hyde will be served. Hyde is also in negotiation for another tramway from Hyde through Dukinfield, Stalybridge, and Mossley.

Johnstone.—Mr. Lea, representative of the British Electric Tramway Company, had an interview last week with Johnstone Town Council with a view to establishing electric tramways.

Kearsley.—Messrs. Lacey, Clirehugh & Sillar have been appointed consulting engineers for the tramway scheme.

Leeds.—At the Leeds County Court on 15th inst., Thomas Harmer (72), chemical manufacturer, recovered £25 from the Corporation for injuries received. He was stepping on to an electric car when it was started with a jerk, throwing him to the ground.

Manchester.—The Tramways Committee on Tuesday adopted a report by a special sub-committee which had been appointed to obtain information and to report as to the future administration of the tramways department. The report suggests the adoption of a general scheme of organisation prepared by the chairman of the Committee. This provides for the division of the organisation into two groups, one being the constructive and the other the administrative group. On the constructive side there are to be two sub-committees, one each for works and permanent way, and on the administrative side also two sub-committees, one for traffic and staff and the second an audit sub-committee. Under the two first of these sub-committees the chief officer will be the consulting engineer (Mr. C. H. Wordingham, the city electrical engineer), and under his direction will be a car works manager, a permanent way engineer, and electrical engineering assistants, who again will be in command of their respective staffs. The general manager will be answerable to the sub-committees on the administrative side, and will direct the duties of the outdoor superintendent, parcels superintendent, accountant, and chief clerk, under each of whom a special staff will operate. The works sub-committee is new, and it is proposed to delegate to it all the duties as to the provision of cars, car sheds, and works now in the hands of the Cars, &c., Sub-committee, whilst the latter sub-committee will become the Traffic and Staff Sub-committee. The Committee recommend the following arrangements and appointments of staff:—That Mr. J. M. McElroy (now secretary to the Committee) be appointed general manager at a salary of £400 per annum. That advertisements be at once issued for an accountant at a commencing salary of £200 per annum, a chief clerk at a commencing salary of £150 per annum, and a chief electrical assistant—applicants to state the salary they require. The special sub-committee have already visited London and obtained much useful information as to tramway administration from the London County Council, the North Metropolitan Tramways Company, the London General Omnibus Company, and they will, at a later stage, when they have had opportunities of inspecting other large tramway undertakings, submit a further report on the system of administration. Inquiries are being made as to premises suitable for the general offices of the department. The need for close organisation is indicated by the statement of a few facts. Tenders for no less than 450 electric tramcars have already been advertised for, and a contract has been placed for 5,000 tons of rails, the first delivery of rails to be made next April. As soon as the delivery is made the work will be begun of reconstructing the tramways in such a way as to suit the overhead trolley system. The first parts of the tramways to be dealt with will be the routes of Cheetham Hill, Bury New Road, and Rochdale Road. The relaying of the lines in other districts will gradually follow.

Musselburgh.—The Town Council last week had before it an agreement with the Drake & Gorham Electric Syndicate re electric tramways. It was decided to defer signing the agreement until a special meeting had been called.

Portsmouth.—The particulars of the claim of the Portsmouth Street Tramways Company and the Provincial Tramways Company against the Portsmouth Corporation for the compulsory acquisition of their undertakings have been deposited with the town clerk as a necessary preliminary to an inquiry before the arbitrator. The total claim amounts to £311,042 1s. 3d. Particulars of tenders received for electric cars appear under "Contracts Closed" this week.

South Staffordshire.—The Earl of Jersey and Colonel Boughey, light railway commissioners, heard evidence last week at the Town Hall, Willenhall, as to the proposed light railway from (1) Willenhall to Bilston; (2) Bilston to Ettingshall; and (3) Bilston to Bradley, promoted by the South Staffordshire Light Railway Traction Company. Mr. S. Morse, solicitor to the promoters, said the scheme was the outcome of suggestions made by the Willenhall and Bilston Urban District Councils. The only way of working the tramways in a satisfactory manner was to have them in the hands of one company. The length of the line from Willenhall to Bilston is under 1½ miles, from Bilston to Ettingshall about ½ mile, and from Bradley to Bilston just over ½ mile. The cost of the undertaking was estimated at £29,000 with equipment. There would be little difficulty as regards gradient; but at the corner of Bank Street and Highfield Road there was a narrow place which it was proposed to widen. Evidence in favour having been given by the two District Councils concerned, Earl Jersey signified his intention of recommending the sanction of the order to the Board of Trade.

Stirling.—Negotiations have been resumed between the Police Commissioners and the Stirling and Bridge of Allan Tramways Company with reference to the transfer of the company's undertaking to the British Electric Traction Company.

Swansea.—At the annual dinner of the Swansea tramways employés last week, Mr. D. Sugrue, J.P., the superintendent of the South Wales district for the British Electric Traction Company, responding to a toast, said the Swansea Improvements and Tramways Company and the British Electric Traction Company had come as a boon and a blessing to the people of Swansea. Work had been done by the allied companies which had never been properly appreciated by the town. At the present time, though the companies had relaid the line and spent a large amount of money with a view of improving the service between the outlying districts and the heart of the town—a service which could not fail to improve the trading connection between the town and the outlying districts—they were, unfortunately, meeting from the Corporation of Swansea successful opposition to projects which were conceived chiefly with a view of completing the system to Swansea. Actuated, he had no doubt, by the highest motives, but yet, he contended, by mistaken views, the Corporation had prevented them making extensions which every man in Swansea admitted were not only desirable, but necessary. What was the Corporation now going to do? It was clear that it could at present exercise no rights over the roads now in the possession of the companies; it was obvious that until it could do that it could not itself carry out the extensions it had prevented the companies he represented from making. If the extensions were to be carried out, the Corporation must approach the companies, for after the way the companies had been treated they certainly would not approach the Corporation.

Whitefield (Lancashire.)—The District Council last week resolved to apply to the Board of Trade for a provisional order to construct and work tramways. The application is stated to have reference to the proposed electrical tramways from Eccles to Whitefield.

TELEGRAPH AND TELEPHONE NOTES.

The Cables to South Africa.—The *Daily News* says for the fourth time since the war began cable communication by one of the two lines connecting us with South Africa has been interrupted. This time it is the cable along the East Coast of Africa that is broken, and the damage is owing to a terrific cyclone that has raged at Mozambique. Houses have been blown down and the ships in the harbour wrecked. The telegraph station, we are informed by the Eastern Telegraph Company, has been unroofed, but the instruments have been saved. As soon as the storm subsides the line will be promptly repaired, and this will no doubt take less time than having to pick up the cable a long distance out at sea, as was the case on the two previous occasions when the East Coast wires were broken. The cable between San Thomé and Loanda, in West Africa, was, fortunately, repaired at the end of last week, or we should now be cut off altogether from communication with the seat of war.

The Continued Interruptions to the Cape Cables.—Last week, when detailing the interruptions to the cables which reach the Cape by the East and West Coasts of Africa, we expressed a hope that during the period of interruption then existing to the West Coast route the cables on the East Coast would hold out, thus saving us from being totally cut off from the Cape. This was fortunately the case, as the San Thomé to Loanda cable was repaired on Saturday last, but only just in time; the Delagoa Bay-Mozambique cable breaking down again last Monday. Altogether during the last two months one or other of these routes to the Cape has been useless, owing to interruption, for more than half the time.

Dewsbury Telephones.—At a meeting of the Dewsbury Chamber of Commerce last week complaint was made that Dewsbury had been left out in the cold in respect to the proposed reduction of charges in telephones, owing, it is stated, to some differences existing between the Town Council and the company.

French International and Colonial Cable Schemes.—The daily press of Paris announced on Saturday last that the Turkish Government is now examining a communication received from the French Government relating to a cable landing at Jaffa (Palestine). The project seems to be the laying of a cable from Marseilles to Jaffa, and a landline from the latter place across Arabia to the Persian Gulf, whence Madagascar, Mahé (in India), and other French colonies can be reached. In the Chinese seas the Eastern Extension Company will be expropriated, their Saigon-Hué-Tonquin cable being taken over by the French Government. Tonquin will then be connected direct to the system of the Great Northern Telegraph Company, whose lines reach Amoy through Russia, Siberia, and Japan. In other directions the French Government will acquire a line of communication from Oran (in Algeria) to Senegal, touching at Tangiers. From Senegal the other West African colonies of France will be reached by purchasing the West African Telegraph Company's system, or by subsidising a new French line. The Government does not consider the matter of prime importance, but, nevertheless, says *Le Temps*, contemplates the establishing of a cable between Senegal and Brazil.

Grantham Telephones.—Arrangements are in progress, on the part of the National Telephone Company, for opening a telephone exchange at Grantham. The erection of poles is being rapidly proceeded with.

Imperial Telegraphic Communication.—Following up Sir E. Sassoon's able speech on this subject, "A Parent" writes to the *Times* to mention an illustration of the present working of the prohibitive system. Although he has had three sons in India for some eight or ten years (one of them in the Civil Service, and two in the Army) up to the present time not a telegram has passed between them. Numerous cases, of course, have arisen when they would have been glad to have telegraphed, but the high prices deterred them. If the tariff had only been reasonable, many telegrams would have passed. "The companies, in insisting upon such high terms, are practically shutting the door to such communications, manifestly against the interest of the shareholders."

Leith.—The District Council has appointed a sub-committee of the General Purposes Committee to deal with the provision of better telephonic, telegraphic, and postal facilities for the borough.

Manchester Telephones.—The Special Telephones Committee of the Manchester Corporation last week received a reply from the Glasgow Corporation to a letter seeking an interview with them, and it was determined that a deputation consisting of Alderman Higginbottom, Councillors Brocklehurst, Phythian, and Plummer should wait upon the Glasgow Corporation at an early date. It was also decided that an interview shall be sought with the Salford Corporation, and the town clerk was instructed to make the necessary arrangements. The object of the interview is that of generally furthering municipal policy in regard to telephony. It was reported to the committee that at a recent meeting of the Association of Municipal Corporations, the following resolution was carried:—"That the secretary of the association be instructed to ascertain what boroughs in the United Kingdom are contemplating the establishment of a municipal telephone service under the provisions of the Telegraph Act, 1899, with a view to a conference of such municipalities being held."

A conference was held on Tuesday at the Manchester Town Hall between representatives of the special telephone committees of the Manchester and Salford Corporations in regard to the question of establishing common action between the city and borough. A very general desire was expressed at the conference in favour of common action in connection either with the municipalisation of the telephones or the granting of a license to a new company. A deputation from the Manchester committee left for Glasgow on Monday evening, and negotiations will be resumed when they have reported the result of their consultations with the Glasgow committee.

Pollokshaws Telephones.—The Council has agreed that no decision on the proposals of the National Telephone Company to introduce a new system of charging in the Glasgow area be arrived at until the result of the scheme of the Glasgow Corporation is ascertained.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899 }	Nov. 9, 1899,
Do. do. (1891 duplicate)	Oct. 6, 1899 }	one cable restored.
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Saint Thomé-Loanda	Dec. 11, 1899 ...	Dec. 16, 1899
Mozambique-Lourenço-Marques	Dec. 18, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication with Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
San Domingo landlines	Dec. 15, 1899 ...	Dec. 16, 1899
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibagua, Manizales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...
Indo-European lines between Odessa and Kertsch	Dec. 12, 1899 ...	Dec. 14, 1899
Indo-European lines between Odessa and Kertsch	Dec. 12, 1899 ...	Dec. 18, 1899
Indo-European lines between Odessa and Hertsch	Dec. 20, 1899 ...	...
Saigon-Bangkok	Dec. 16, 1899 ...	...

The Telephone Service.—At a meeting of the St. Giles's Board of Works on Tuesday, Mr. R. W. Dibdin, J.P., (chairman) in the chair, the Law and Parliamentary Committee reported that they had considered the letter of October 31st, from the secretary to the Post Office, as to the rights of the National Telephone Company of laying telephone wires and pipes under the streets. They recommended that having regard to all the circumstances of the case, no action be taken in the matter. Mr. E. Upton, in moving the adoption of the report, said that it would appear that some time ago the Post Office authorities entered into a covenant with the National Telephone Company to allow them to lay their wires in the trenches which they opened for telegraph purposes. The Post Office authorities had since changed their mind, and a rivalry now existed between them and the Telephone Company. He did not think that they (the board) should do anything to prevent the Telephone Company from laying their wires. Neither the Post Office nor the Telephone Company had authority to open the streets, and if they did the local authority could take action against them. The report was adopted.

A conference of representatives of boroughs in Kent and Sussex was held in the Town Hall, Hastings, on Wednesday last week. It was resolved to write to the Postmaster-General asking for definite information with regard to the several points discussed, and another meeting is to be held for the further consideration of the subject.

Telephone to Belgium.—The *Daily Chronicle* Brussels correspondent telegraphs that recent experiments with the view of connecting Brussels and London by telephone have been so successful that the negotiations have entered upon a practical stage, and a convention on the matter is about to be signed by the respective Governments. The wire will be carried through Lille, Calais and Dover.

Wireless Telegraphy.—Before the Indian Section of the Society of Arts on 14th inst. Colonel R. C. Temple, Chief Commissioner of the Andaman and Nicobar Islands, read a paper entitled "Round About the Andamans and Nicobars," in which considerable and interesting reference was made to the utility of wireless telegraphy for establishing convenient communication between the islands. In a report in the *Times* of 15th inst. we read that Colonel Temple

suggested setting up a system of wireless telegraphic communication between the Andamans and India, in view of the great importance of the islands as meteorological stations, whence timely warning of cyclones could be given to shipping all over the Bay of Bengal. In dealing with this question, the lecturer stated that the idea of telegraphic communication between the Andamans and India was an old one, which had on more than one occasion reached the point of plans and estimates, but the overwhelming obstacles hitherto had been the physical difficulties and the great cost of laying a cable. The arrival of wireless telegraphy essentially changed the old conditions. The point to get at was Port Blair, which was such a long way by sea from anywhere—roughly, 1,000 miles from Madras, 750 miles from Calcutta, 350 miles from Rangoon—that at the first blush it seemed absurd to talk about reaching it by wireless telegraphy. But if one would carefully look at a general map the apparent impossibility at once disappeared. Roughly speaking, the Andamans on the one hand, and Narcondam, Barren Island, and the Invisible Bank on the other, were in reality the tops of submerged mountain ranges connected with the Asiatic Continent through Burma, while the Nicobars were the tops of a similar range connected with Sumatra. And, as a matter of fact, if the string of islands were viewed as a whole, the longest distances from the coast of Burma, from each other and from Sumatra were quite trifling. It would be perceived that telegraphic communication could be set up along the whole line of islands, either by the wireless system alone or by its combination with the ordinary overland wires, the portion of the route which it would be obligatory to bridge over by wireless telegraphy being the sea stretches. These were all that need be considered now, and the lengths of the stretches in question were in no case prohibitive. At Diamond Island, in the extreme north of the map, was an important telegraph station, used by ships awaiting orders from Rangoon, Calcutta, &c., and for similar purposes. From Diamond Island to the Alguada Reef, where there was an important lighthouse, was only 10 miles; thence to Preparis Island the distance was 55 miles; thence to the Cocos Islands, where was another important lighthouse, it was 45 miles; thence to Landfall Island it was 30 miles. On reaching Landfall Island one found himself in a long closely-connected string of islands, along which ordinary wires could be stretched to Port Blair, 150 miles. Communication southwards from this point could be extended to the south of Little Andaman with the help of wireless telegraph stations, in no case more than 25 miles apart. From the Little Andaman to Car Nicobar would be encountered the longest sea distance of 70 miles, but the distances onwards were not great; to Chowra, 40 miles; thence to Nancowry, 20 miles; thence to Little Nicobar another 20 miles, whence it was only 30 miles to Parsons Point, in the extreme south of the Great Nicobar. The meaning of all this was that the greatest sea distance to Port Blair was 55 miles, and onwards to the Nicobars it was 70 miles. Now, he was assured, and his own observations made with the kind assistance of Mr. Marconi and his friends, had confirmed him in the belief that anything under 100 miles was not an impossible practical distance for wireless telegraphy; at any rate, 55 miles was an easily feasible distance. To extend the line of telegraphic communication on to Sumatra they would find it 60 miles to Pulo Brasse, and then 15 miles to Acheen Head, whence communication could be run on by land and sea to Singapore or any other selected point in the general cable lines. In this way there could be set up an independent line of telegraph between India and the rest of the world. This, however, would involve co-operation with the Dutch East India Government and other political considerations. But, leaving this point out of the present purview, the fact remained that it was quite feasible to run a line of wireless telegraph stations down the whole length of the Andamans and Nicobars in direct communication with Diamond Island, every one of which could without difficulty be turned into a meteorological reporting station, thus creating that series of stations which it was so essential to have for practically useful meteorological reports. He asked them to consider on the one hand, the quantity and value of the shipping frequenting the Bay of Bengal, the extreme violence of the cyclones, the present difficulty in obtaining such accurate warning of them as would effectively prevent damage to shipping therefrom; and, on the other hand, that, though these islands in the bay were not themselves liable to frequent attack by cyclones, they were within the influence of every one that occurred, usually four days and more, before any part of the coast of India; and then the practical value of a series of meteorological stations down them became at once apparent. He would go further and say that, considering the magnitude of the interests concerned, both as to lives and property, the point was worthy of the very serious consideration of the commercial communities both of this country and India.

Major Flood Page stated that there would be no difficulty when the time came in establishing wireless telegraphy all along the Andaman Islands. He presumed, however, the Indian Government would deal with the problem of wireless telegraphy as a whole, and as to whether it should be applied to the islands first would in some measure depend on the influence which the shipping companies and others interested could bring to bear.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—January 10th. The Town Hall Committee invites tenders for the switchboards, wiring and other works and appliances necessary for the electric light installation in the Town Hall. For specification and to view the various rooms, apply to the Borough Surveyor, Town Hall.

Barnes.—January 9th. The Urban District Council is inviting tenders for the supply and erection of:—(Section A) boilers; (B) steam dynamos and switchboard; (C) storage batteries; (D) cables, &c. Only those firms with plant of a similar size and type working satisfactorily in other electricity works will be allowed to tender. Specifications, &c., of the Surveyor, Council Offices, High Street, Mortlake, on deposit of £1 1s. for each section. Plans, specifications, &c., may be inspected at the offices of the engineer, Mr. William Fairley, 53, Victoria Street, S.W.

Bedford.—The Electric Light Committee wants tenders for one 420-B.H.P. inverted compound double-acting engine, and one 250-kw. alternator. See "Official Notices" December 15th.

Bermondsey.—January 13th. The Vestry wants tenders for the construction, &c., of a dust destructor, with furnaces, water-tube boilers, economiser, fans and forced draught appliances, in connection with the electricity supply undertaking. See "Official Notices" December 15th.

Birkenhead.—January 16th. The Corporation is inviting tenders for the construction of a new electricity generating station in connection with the electric tramways.

Blackburn.—December 23rd. The Corporation wants tenders for overhead trolley line equipment. See "Official Notices" November 24th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for water-tube boiler plant, steam dynamos, switchboard, and accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Dublin.—January 1st. The Dublin United Tramways Company is inviting tenders for the supply of general stores, including car fittings, iron, steel castings, oils, paints, glass, brushes, ironmongery, harness materials, electrical supplies, coal, &c., for the year ending December 31st, 1900. Particulars at the company's offices 9, Upper Sackville Street.

Gloucester.—December 28th. The Electricity Committee wants tenders for extension plant including Lancashire boiler, &c., one 300-KW. steam dynamo, switchboard work, condensing plant. See "Official Notices" November 24th.

Hackney.—January 2nd, 1900. The Vestry wants tenders for the supply of accumulators. See "Official Notices" December 1st.

Hull.—December 28th. The Electric Lighting Committee wants tenders for two 750-H.P. high speed three-crank vertical engines; and two 460-KW. continuous current dynamos (2,250 volts) for the Sculcoates Lane electric lighting station. See "Official Notices" December 8th.

Ilford.—January 20th. The District Council wants tenders for water-tube boilers, economiser, pumps, pipe work, two 200-kw. and one 100-kw. dynamos, motor boosters, battery, switchboard, 15-ton traveller, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" December 15th.

Manchester.—December 30th. The Tramways Committee wants tenders for 450 electric tramcar bodies. See "Official Notices" December 15th.

Melbourne.—March 1st. The Corporation is wanting tenders for boilers, engines, dynamos, switchboard, feeders, mains, arc light leads, accumulators, &c., for electric lighting. See "Official Notices" this week.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—January 24th. The Corporation wants tenders for laying down about 11 miles of double line tramway, the rails, fastenings, and the poles being supplied by the Corporation. See "Official Notices" this week.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Salford.—January 8th. The School Board invites tenders for the electric lighting of the new schools in Grecian Street North, Lower Broughton. See "Official Notices" to-day.

Spain.—January 16th. Tenders are being invited until January 16th by the municipal authorities of Utrera for the concession for the electric lighting of the town by means of 300 10-C.P. lamps and 100 16-C.P. lamps. Tenders to be sent to El Secretario del Ayuntamiento de Utrera (Spain) whence particulars may be obtained.

Tunbridge Wells.—January 15th. The Corporation invites tenders for condensing plant to deal with 30,000 lbs. of steam per hour. See "Official Notices" to-day.

West Bromwich.—December 22nd. The Corporation wants tenders for boilers, steam dynamos and condensers, switchboard, mains, and storage battery, for electricity supply. See "Official Notices" December 8th.

CLOSED.

Bradford.—The Corporation has ordered 25 electric car bodies from the Brush Company, and trucks and trolleys for same from Messrs. Blackwell.

Farnworth.—The contracts for the overhead equipment and the bonding of the rails to the specification of Messrs. Lacey, Clirehugh & Sillar, have been placed with Messrs. G. Hill & Co., of Manchester. The work will be commenced this week.

Hammersmith.—The Vestry on Wednesday evening decided to accept the tender of Messrs. Marshall, Fleming & Jack, £540, for a new 25-ton overhead traveller crane for the electricity works.

Liverpool.—The contract for overhead electrical equipment for 10 miles of tramway has been placed with Messrs. Blackwell. The Corporation has also ordered two economisers for the Lister Drive power station from Messrs. Green & Son at £513 each.

London.—The St. Pancras Vestry on Wednesday considered the following tenders for the supply of two dry back marine boilers for the Regent's Park station.—

Samuel Hodge & Sons	£3,825
John Fraser & Son	3,400
Fraser & Fraser, Limited	2,991
E. Danks & Co. (Oldbury), Limited (accepted)	2,645

The undernoted firms tendered for the supply of feed-water heaters:—

W. Boby (accepted)	£1,495
J. E. & S. Spencer..	1,017
Edwards & Barnes	889

The selection of the highest tender was due to the advice of the chief electrical engineer who expressed the opinion that the type of heater proposed would produce the most satisfactory results.

Portsmouth.—At a meeting of the Town Council last week the Tramways Committee submitted the following tenders for the supply of cars for electrical working, and on their recommendation the tender of Messrs. Dick, Kerr & Co., for the supply of 60 cars at the price of £34,382 11s. 6d. was accepted, with power for the Corporation at any time during the year 1900 to order 20 additional cars on the terms of the present tender and specification. The price named provides for the cars complete, and also for a sum of £500 for contingencies mentioned in the specification, which will be under the control of the committee. The tenders as worked out with the several extras required for the cars give the following prices:—

	40 cars.	60 cars.	80 cars.
	£ s. d.	£ s. d.	£ s. d.
Messrs. Blackwell & Co.	25,273 18 10	37,218 8 10	49,162 18 10
The Westinghouse Electric Co. ..	24,558 10 0	36,091 15 0	47,625 0 0
The Brush Elec. Engineering Co...	23,488 8 0	34,573 8 0	45,656 8 0
Messrs. Dick, Kerr & Co.	23,402 11 6	34,382 11 6	45,362 11 6
Messrs. McCartney, McElroy & Co.	21,931 0 0	....	....

Pontefract Union.—The contracts for electric lighting (400 lamps) have been placed with the Morley Electric Engineering Company, Limited, for plant, and the wiring of premises with Mr. E. C. Wallis, of Leeds. Consulting engineer, Mr. G. R. Peers, of Manchester.

St. Helens.—The Corporation has accepted the tender of Messrs. Yates & Thom for boilers; of the Chloride Electrical Storage Syndicate, Limited, for accumulators, and of the British Insulated Wire Company, Limited, for tramway feeders.

Swansea.—The Electric Lighting Committee has accepted the tender of Messrs. Yates & Thom for boilers, steam pipes, &c., at £10,800.

Wrexham.—Mr. George R. Peers, consulting electrical engineer of Manchester, writes us as follows:—"In your last week's issue I notice that you give the list of tenders received for the Wrexham town lighting scheme, and that you say the consulting engineer is Mr. Trentham. I should be glad if you would kindly correct this in your next by stating that Mr. Trentham and I are joint engineers for this scheme. We are working in a similar capacity for Rhyl Council."

NOTES.

Christmas Greeting.—The year has been a very prosperous one to the electrical fraternity, and no one, unless he be a veritable Scroodge, will grudge the brief spell of idleness that Christmastide brings with it. Abroad there is a beclouded horizon, but our healthy optimism will prevent this unduly interfering with the pleasures of the festive season. To every contributor, reader, advertiser, and our many other friends, we heartily wish a right merry Christmas.

Royal Institution.—The first of the Royal Institution Christmas lectures to young people, by Charles Vernon Boys, Esq., F.R.S., M.R.I., on "Fluids in Motion and at Rest," experimentally illustrated, will be delivered next Thursday, December 28th, at 3 o'clock. The other five lectures are arranged for December 30th, January 2nd, 4th, 6th and 9th, 1900.

Among the arrangements for Friday evening meetings before Easter, 1900, are the following:—January 19th, Lord Rayleigh on "Flight"; January 26th, Hon. C. A Parsons, on "Motive Power—High Speed Navigation—Steam Turbines"; February 2nd, Signor G. Marconi, M.I.E.E., "Wireless Telegraphy"; March 23rd, Sir Andrew Noble, "Some Modern Explosives"; April 6th, Prof. Dewar, "Solid Hydrogen." A series of six lectures on "Polarised Light" will be delivered by Lord Rayleigh on Saturdays, March 3rd, 10th, 17th, 24th, 31st and April 7th.

"Science Abstracts."—With the December number of this valuable periodical, it is announced that the date of issue will in future be the 25th of each month—except, we presume, December! Further, the scope of its operations is to be considerably extended; a section will be added dealing with steam plant, gas engines, oil engines and motor cars of *all* kinds. This is a step of which we heartily approve; it is given to no publication to be all things to *all* men, but it is well to cater for as many of them as possible. Among other interesting articles abstracted in the current issue are the following:—The Aron meter (new type); a 5-H P. steam engine for motor cars, consuming only 20½ lbs. water per H.P.-hour; theory of induction motors; electric traction statistics; measurement of resistance by damping, &c.

Workhouse Work Wanted.—The *Councillor and Guardian* for December 9th contains the following advertisement:—

TO BOARDS OF GUARDIANS.

A CONSULTING ELECTRICAL ENGINEER, who has in hand several installations of electric lighting at Workhouses, will PREPARE REPORTS and SCHEMES for similar buildings upon moderate terms. Address—
ELECTRICAL ENGINEER,
c/o Councillor and Guardian,
29, Old Queen Street, Westminster.

Need we ask why this is anonymous?

Personal.—The Court of Common Council has appointed Mr. H. L. Dixon, assistant to the Corporation electrical engineer, to the post of inspector of overhead wires at a salary of £208 per annum. Previous to joining the Corporation, Mr. Dixon was erecting electrical engineer for Messrs. Manlove, Alliott & Co., Limited, Nottingham, and was for nearly two years mains foreman to the National Electric Supply Company, Limited, Preston.

Our New York namesake has the following interesting note:—"Among recent foreign arrivals in New York city are Managing Director Monks, Mr. H. F. Parshall, and Mr. W. E Baylor, of the British Thomson-Houston Company, London; Mr. A. K. Baylor, London; Mr. R. W. Blackwell and Mr. H. Lomas, of R. W. Blackwell & Co., Limited, London. These gentlemen are visiting the United States to look into the state of the American electrical trade, especially with reference to export orders.

Out of 33 applicants the Electricity Committee of the Eccles Town Council have selected Mr. James Moss, of Derby, for the post of electrical engineer for the borough.

Mr. Arthur Martin, the district manager at Liverpool of the National Telephone Company, has been promoted to be assistant superintendent of the northern province, which comprises Yorkshire, Northumberland, and Durham. Mr. Martin goes from Liverpool to Leeds at the beginning of the new year.

Mr. Arthur E. Cotterell, who has been for several years district manager in Birmingham for the National Telephone Company, Limited, has been promoted to the position of assistant provincial superintendent for the Midland province. The position which he vacates will be filled by Mr. J. W. F. Ashwin, who is at present district manager to the company at Edinburgh.

An Electrical Fire.—In the *Times* of Tuesday last a letter, under the heading "A Remarkable Fire," appears over the signature of Mr. Montague Crackanthorpe, Q.C.

The writer graphically describes what must admittedly be termed a sufficiently alarming electrically-caused fire. From the description given it appears that the ceiling-rose connection for the room below was the incendiary, and according to the explanations of "the electrical engineer responsible for the wiring," and a "highly intelligent official" from the electrical department of the London County Council, by some "unexplained mischance" (the fire itself having destroyed all direct evidence of its origin), the insulating covering of the wires must have become injured, and, in spite of the "safety" fuse, the resultant arc of short circuit ignited the inflammable surroundings.

"Jerry wiring," or an imperfectly made or unsoldered joint could readily accomplish the result described.

We do not at this moment criticise the particular wiring in question, but wish to point out that the publication of the occurrence will accentuate the pressing necessity for the simplification, better standardisation and unification of the insurance company and supply station wiring rules. Some course of action should be decided upon under which all the insurance offices will find it desirable to effectively second the efforts of the Institution of Electrical Engineers.

More attention must be given to the suitability of the material installed.

Under the existing conditions methods of wiring which admittedly possess inherently a larger factor of safety than obtains with wood casing have no proper official recognition; nothing, in fact, beyond the arguments of their respective champions to encourage their adoption and extended use. "Wood casing," on the other hand, gets specific mention, but as all are equally accepted and passed, a premium is virtually placed on the "cheapest" in first cost.

This, again, means that low-priced material is fostered to the exclusion of the more expensive and probably more suitable, and the use of the cheapest material naturally calls forth the lowest cost and least reliable class of labour.

Undoubtedly the general public demand "low cost" wiring, and there is a tendency to supply it, but the true interests of the public and our electrical industry are best served by providing for and encouraging the growth of that class of wiring which provides inherently the greatest safety and freedom from incidental trouble.

The Copper Market During the First Half of December.—According to the last issue of Messrs. H. R. Merton & Co.'s statistical circular relating to copper, stocks have fallen 1,867 tons since December 1st, while prices have likewise fallen 25s. per ton. The detailed figures are as follows:—Total supplies, 14,617 tons; total deliveries, 15,434 tons; shipments to America, 550 tons. Stocks November 30th, 25,765 tons; stocks December 18th, 24,398 tons. Price G.M.B.'s November 30th, £73 15s.; ditto, December 15th, £72 10s. The supplies during the first half of December have been above the average, but deliveries have also increased in even greater ratio. In each case the increase is no doubt due to the approach of Christmas, and to the desire to obtain deliveries before the interruption of business by the holidays.

Smoke Prevention at Hammersmith.—At the meeting of the Hammersmith Vestry on Wednesday evening it was decided that, owing to the uncertainty of obtaining a continuous supply of Welsh coal for the electric lighting station, a set of Gregory's patent smoke consumers be fixed to one of the Babcock boilers, so that in the event of the North Country coal having to be used, the smoke might be kept down as much as possible. The estimated cost was £18, and in the event of the "consumers" not being satisfactory after a month's trial, they will be removed by the patentees, and no charge whatever be incurred by the Vestry.

Electric Shock Accident.—On 18th inst. a labourer employed at Messrs. Grandage & Co.'s dyeworks, Brownroyd, fell, and caught hold of an electric light wire, receiving a severe shock. He was conveyed to the Royal Infirmary, and detained there.

Lecture.—At the Glasgow and West of Scotland Technical College on 15th inst., Prof. Henderson, MA., D.Sc., lectured on "Electricity Applied to Chemical Manufactures."

Appointments Vacant.—A chief assistant engineer is wanted for the new electricity works at Gloucester, also a cable jointer. See "Official Notices" this week.

Stealing Electricity.—A Bill concerning the theft of electricity by tapping the wires has been laid before the German Federal Council.

NEW COMPANIES REGISTERED.

Reid, M'Farlane & Co., Limited (6,428).—This company was registered in Edinburgh on December 14th, with a capital of £7,500 in £5 shares, to acquire the business of Reid, M'Farlane and Co., of Glasgow, and to carry on the business of non-conducting composition manufacturers, &c. The first subscribers (each with one share) are:—J. M'Farlane, 25, St. Andrew's Drive, Pollokshields; Duncan M'Farlane, 58, Hyde Park Street, Glasgow, engineer; G. M'Farlane, 25, St. Andrew's Drive, Pollokshields, clerk; D. A. M'Farlane, 58, Hyde Park Street, Glasgow, engineer; James M'Intosh, 58, Hyde Park Street, Glasgow, manufacturer; T. M'Intosh, 58, Hyde Park Street, Glasgow, engineer; D. Smith, 58, Hyde Park Street, Glasgow, manufacturer; and Mary M'Intosh, 15, West Clarance Street, Glasgow. The number of directors is not to be less than three nor more than five; the first are J. M'Intosh, D. M'Farlane, T. M'Intosh, and D. M'Farlane; qualification, 50 shares; remuneration of chairman, £400 per annum; others, £150 each per annum. Registered office, 58, Hyde Park Street, Glasgow.

SUPPLY STATION ACCOUNTS.

Hanley Corporation Electricity Accounts.

The accounts of the electricity supply undertaking of the Hanley Corporation show a rather remarkable result in connection with the revenue and gross profit. The total cost of production per unit remains practically unaltered, but the revenue per unit has fallen by more than ½d., and this, coupled with about £100 increase in interest and repayment charges, shows a greater loss last year than in 1897. The curious thing is the appearance of a minus quantity in the "increase" column of the "general statement" against the *gross profit* item.

The explanation is well known to those who have read the history of the fight between the local tradesmen's association and the Corporation on the question of rebate scale, and the method to be adopted in charging for electrical energy. An elaborate report was issued some months ago, defending the rebate scale principle, and with it we quite agree. Messrs. Lobley and Cowell, the borough engineer and borough electrical engineer respectively, have done all that is possible to show the logical position taken up in this matter, but the traders have failed apparently to appreciate the advantages offered, or more than 2,700 lamps would have been connected during the past year. It is perhaps a pity that the correct method of charging was not adopted at the initial stage of the business.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£51,634	£60,785	£9,151
Number of units sold	351,762	474,247	122,485
Number of lamps connected ...	23,314	26,040	2,726
Gross revenue	£6,520	£7,715	£1,195
Gross profit	£2,520	£2,420	−£100
Average price per unit sold ...	4·3d.	3·79d.	−·51d.

The reason for the augmented loss is shown by the revenue statement, for it will be noticed that the operation of the scale has been to reduce the return per unit from 4·45d. to 3·9d., a greater proportionate ratio than could be afforded with an increase of 122,000 units produced at the approximately same rate as in the previous year. No doubt the results of the current year's working will show a restoration to the old position, or even something better. It ought to be so, and one would only recommend the good people of Hanley to look around them and see how the rebate principle has assisted consumers in other towns.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£6,292	4·30d.	£7,486	3·79d.	−·51d.
Meter rents	150	·10d.	215	·10d.	...
Supply of lamps, &c.	...	...	14	·01d.	+ 01d.
Sundry	78	·05d.	...	...	−·05d.
Gross revenue	£6,520	4·45d.	£7,715	3·90d.	−·55d.

A total quantity of 551,259 units was generated. 118,494 units were used in 60 400-watt arc lamps; 4 500-watt arc lamps, and 69 incandescent lamps, all for public lighting; private consumers took the balance of 355,753 units. The maximum load during the year was 460 KW.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase
Coal and other fuel	£1,003	·68d.	£1,398	·71d.	+·03d.
Oil, waste, water, and engine room stores.	226	·15d.	331	·17d.	+ 02d.
Salaries and wages incurred in generation and distribution.	887	·60d.	1,208	·61d.	+·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	992	·67d.	1,176	·59d.	−·08d.
Works' cost	£3,108	2·10d.	£4,113	2·08d.	−·05d.
Rent, rates and taxes ..	357	·24d.	553	·28d.	+ 04d.
Management and expenses, salaries of managing engineer, secretary, clerks, &c.	535	·36d.	536	·27d.	−·09d.
General establishment charges, stationery and printing, law charges and insurance	...	...	93	·05d.	+ 05d.
Other expenses	...	...	...	...	...
Total costs ...	£4,000	2·70d.	£5,295	2·68d.	−·02d.

In our analysis of these accounts last year (March 25th, 1898), we referred to the short period for which the loans were granted, and also quoted the then report where it reviewed the results of changing the rate of charge for energy. The engineering costs are not unfavourable, as there has been a marked rise in cost of coal, &c., during the period under review, and when larger units of plant are started, unless consumers come on at a reasonable rate to fill them up the works' costs in individual items are sure to suffer. As a result, we find the rises in coal, oil, &c., and wages, nearly balance the reduction in the case of repairs. Rent, &c., is heavy, but "management" remains the same, with a new item of nearly £100 for general establishment charges.

Profit Statement.

	1897.	1898.
Interest on loans	£2,709	£1,156
Sinking fund for repayments		1,316
Net profit*	−189	−412
Gross profit	£2,520	£2,420

* Deficiency charged to rates.

CITY NOTES.

India-Rubber, Gutta-Percha, and Telegraph Works, Limited.

The thirty-sixth ordinary general meeting of the shareholders of the above company was held on Thursday, December 14th, at the Cannon Street Hotel, the Hon. Henry Marsham presiding.

The Chairman, in proposing the adoption of the report, said: Gentlemen, you will have noticed that in accordance with the resolutions passed at the extraordinary general meeting held in July last the report and accounts now submitted are for a period extending over nine months, and that in the future our financial year will terminate on September 30th in each year instead of on December 31st as heretofore. This change has entailed some extra trouble to our staff for the present year, but from our experience we believe that even in this case the balance of benefit has been on the side of the new date. There is little doubt that the full advantage of the change will be felt next year. In comparing the present balance-sheet with that presented at the yearly meeting held in February last, the only substantial differences to be noticed are due to the company at present holding a larger stock of raw material. From my remarks at the half-yearly meeting held in July last, you must have gathered that your board in view of probable work had been purchasing larger quantities of gutta-percha than the immediate requirements demanded. It is well that we took this precaution, because since we bought, owing to an extraordinary increase in the consumption of this gum, the available stocks have seriously diminished. In the profit and loss account debit side you will notice that in addition to the usual depreciations the figures include a depreciation of the ss. *International*. During this year we sold the vessel, and as we made a loss in the sale we have charged this loss against revenue. The general business of the company has been fairly profitable, and the turnover has exceeded that of the similar period of 1898. In trading we are encountering keener competition every day, and it is much to be hoped that the prices of raw materials will not remain at their present high standards. Since I last addressed you we have been obliged to advance our list prices of certain goods, and it is probable that we shall have to make a further advance in other lines. Our electrical machinery department has been very busy, and, in addition to work done for our own factory at Silvertown, has completed installations for several municipalities, amongst others, Leith, Canterbury and Greenock. As I am addressing you to-day the official reception of the work done by us at Hereford is taking place. At the half-yearly meeting I informed you that our ss. *Dacia* was about to start for the West Indies to lay a new cable for the International Ocean Telegraph Company of New York, and I have now to state that she successfully completed her task. We have in course of manufacture about 1,000 miles of cable for the Commercial Cable Company. This cable will be laid next year between Canso and New York.

Mr. S. W. Silver seconded the motion, which was carried unanimously.

The Chairman, in thanking the meeting for re-electing him as a director, said that recently he had had an opportunity of visiting the works at Persan, and, according to his judgment, they were in very good condition, and were doing very good business.

South Staffordshire Tramways Company.

An extraordinary meeting of the proprietors of the South Staffordshire Tramways Company was held at Cannon Street Hotel, on 15th inst., for the purpose of considering the provisions of a conditional contract dated November 23rd, 1899, and made between this company, the British Electric Traction Company of the second part, the South Staffordshire Tramways (Lessee) Company of the third part, and the Mayor, aldermen, and burgesses of the borough of Walsall of the fourth part, being a contract for the sale to the Corporation of Walsall of a portion of the undertakings of the South Staffordshire Tramways Company within the borough of Walsall, and for other purposes.

Mr. W. Somers Schuster, who presided, said that the periods at which the various local authorities through whose areas the tramways run might (under the provisions of the Tramways Act of 1870) purchase the parts of their undertaking which were within their respective boundaries were drawing near. The proximity of these dates had caused the directors great concern, and they had, therefore, assiduously devoted themselves to endeavours to find some means by which a future interest in all or part of the South Staffordshire tramways might be retained for the shareholders of the company. The directors would have been glad if all the local authorities were willing to postpone their right of purchase; but, unfortunately, there appeared to be a general desire on the part of the authorities to purchase the lines, and so obtain entire control of their roads. Some of the authorities appeared to contemplate subsequently working their own lines, but the South Staffordshire tramways depended absolutely upon giving a means of inter-communication between different towns, and the directors were able, from their experience, to state confidently that the company's tramway system required extension rather than cutting up, and that it could not be profitably worked except by a central authority. Walsall appeared to have had the right to purchase a piece of the line at what was popularly known as "old iron" price 12 years after the granting of the provisional order, and without paying any compensation for goodwill and disturbance. The whole situation was complicated and fraught with difficulties, and the directors thought that the agreement submitted to the shareholders offered an equitable solution of the question. The object of the agreement was to avoid litigation. They had obtained an independent valuation, and the result was that the plant, &c., was valued at £18,500. The resolution, seconded by Mr. Dawson, was carried unanimously.

Calcutta Tramways Company.

The ordinary general meeting of the shareholders of this company was held at Cannon Street Hotel, Mr. E. C. Morgan presiding. He said they had been endeavouring to come to an agreement with the Calcutta Corporation for the introduction of electricity. On June 14th last pourparlers took place with the municipal authorities, and negotiations were renewed. The settlement of certain details was referred to a sub-committee for report. Various alterations and amendments had been made, and the agreement has now been signed and sealed. The delay in carrying out the arrangement had not been due to the board's action, for they had done all in their power, even to the extent of yielding on points where they had a right to stand firm, so that they might carry out the beneficial change with all speed. Besides the agreement with the Corporation they had a second agreement with the Government of Bengal in reference to the lines upon the Maidaun. For years past they had been endeavouring to obtain permission to double the line which runs from the end of Dhurramtollah to the Kidderpore Bridge, and which is the direct route to the docks. Up to the present time this has been withheld, in spite of their representations as to the inconvenience and delay caused by a single line, but they had now obtained the necessary consent, and a new agreement with the Bengal Government on the same lines as that with the Corporation was in preparation. The double line and the electrical traction will afford the greatest convenience to the business community, and will also be of great advantage to the company by enabling them to meet the growing traffic to the docks. They deemed it desirable some months

back to make preparations to avoid all possible delay in getting forward with the electrical equipment as soon as they were securely placed in a position to do so. They therefore entered into a provisional agreement with a first-class firm of contractors here, who have successfully carried out large works of a similar nature, by which they undertook to provide plans and specifications to the satisfaction of the Corporation, and thereafter to carry out the needful installation for the working of the lines by electricity at net cost of the materials and labour, plus 10 per cent., which was to include all expenses for engineering. The cost of the work is not to exceed a maximum sum—to be a sum named by the contractors and agreed to before the definite contract is signed, subject to abatement should it be found on completion that the cost of materials and labour, plus 10 per cent., falls short of their estimate. They also undertook to maintain the lines for six months. They proposed to put themselves into a position to take advantage of the first favourable opportunity, by creating a new series of 4½ per cent. debentures for £350,000. This included an amount needed for the redemption of the existing 5 per cent. debentures for £100,000, so as to make the new issue a first charge upon the undertaking. The cost of the electrical equipment is an unknown quantity at the present moment, but it will amount to a large sum of money, and besides this they deemed it needful to have a sum in reserve for extensions which will probably be called for soon. There was a large field for profitable extensions. He then proceeded to refer to the increased revenues and other advantages which would accrue from the adoption of electric traction.

The report was adopted.

Electrical Copper Company.

The third annual meeting of this company was held on Wednesday at Abchurch Chambers, E.C.

Mr. A. Fould (deputy chairman) presided. He passed a few remarks upon the report and balance-sheet, and said that the past financial year had not been up to expectations, but as they had to deal with the commercial application of a new process they must proceed with caution and acquire experience prior to erecting plant on a very large scale. Besides the difficulties associated with the novelty of the process, the engines required for driving the plant and other portions of the machinery were not erected according to their expectations, and this resulted in hindrances. They had had some difficulty in connection with their management, but the steps taken will prevent a recurrence of these difficulties. He hoped that the new plant would lead to satisfactory results.

The report was adopted.

The African Direct Telegraph Company, Limited.—This company notifies that the coupons of the 4 per cent. mortgage debentures to bearer due January 1st will be paid at Parr's Bank, Limited, Bartholomew Lane, E.C. Interest warrants on the registered debentures will be sent out on the 30th inst.

Crompton & Co., Limited.—The directors have declared an interim dividend at the rate of 6 per cent. per annum for the half-year ended September 30th, payable on January 15th.

Eastern Extension Telegraph Company.—The directors announce an interim dividend of 2s. 6d. per share.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 16th, 1899, were £96 7s. 3d.: December 16th, 1898, £139 4s. 11d.; aggregate for half-year to date, £19,961 1s. 4d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 15th, 1899, were £2,341 11s. 9d.; corresponding period, 1898, £2,550 0s. 3d.; decrease, £208 8s. 6d.

The City and South London Railway Company.—The receipts for the week ending December 17th, 1899, were £1,151; December 18th, 1898, £1,080; increase £71. Total receipts for half-year, 1899, £24,801; total receipts corresponding period, 1898, £24,833; decrease, £32. Miles open, 3½.

The Dover Corporation Tramways.—The receipts for the week ending December 16th, 1899, were £126 17s. 2d.; December 16th, 1898, £139 11s. 5d.; decrease, £12 14s. 3d. Total receipts to date, 1899, £9,784 17s. 9d.; corresponding period, 1898, £8,909 3s. 0d.; increase, £1,525 14s. 9d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,788; 1898, 4,310. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 15th, 1899, were as follows:—D. U. T. Co., horse cars, £102 18s. 9d.; ditto, electric cars, £2,739 10s. 4d.; D. S. D. Co., electric cars, £594 3s. 11d.; total, £3,426 8s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £2,194 6s. 5d.; ditto, electric cars, £561 6s. 5d.; D. S. D. Co., electric cars, £614 6s. 8d.; total, £3,299 19s. 6d.; increase, £126 8s. 6d. Aggregate to date, £96,876 11s. 4d.; aggregate to date last year, £94,799 18s. 6d.; increase to date, £5,076 17s. 10d. Worked:—The mileage open is 40 miles electrically, 4 miles by horses, as against 16 miles electrically, and 28 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending December 17th, 1899, were £491; December 21st, 1898, £237; increase, £254. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £22,218; 1898, from June 29th, 1898, £6,539. Miles of track open, 12; 1898, 34.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 17th, 1899, amounted to £1,432; corresponding week last year, £1,324; increase, £108; total increase for half-year to date, £1,991.

The South Staffordshire Tramways Company.—The receipts for week ending December 15th, 1899, were £527 0s. 8d.; December 16th, 1898, £603 4s. 1d.; aggregate receipts for 50 weeks £33,178 2s. 4d; 1898, £31,552 17s. 9d.

STOCKS AND SHARES.

Wednesday Evening.

It is a dismal duty that we have to face this week. There is but one way which stocks and shares have moved, and that is downwards. Not a single rise brightens the melancholy aspect of our lists, and the worst part of the situation cannot be seen by a reference to the prices. Most of the quotations have become altogether nominal, and a seller of any amount would find it impossible to get rid of his stock, even at the lowest price that is named. Within the last few days no small quantity of "pawned" securities have been thrown on the market—securities, that is to say, which have been taken up by bankers for their customers on a margin, and which the latter are forced to realise when they can no longer keep up the requisite amount of margin required by the bank. The serious news concerning General Buller's reverse at the Tugela River had a most depressing effect on all the markets of the Stock Exchange, and the semi-panic which broke out in the speculative departments rendered even the strongest sections sensitive. Then, too, Consols are under par, which they have not been since 1894, and the talk of a huge War Loan has naturally reacted unfavourably upon all the markets that are affected by the state of money.

Jobbers in the supply section have marked down prices 10s. at a time when never a share has changed hands. It is feared that Metropolitans in large numbers might be thrown on the market, and the price has been lowered as an intelligent anticipation. It is hoped that the company may "muddle out" of its difficulty at Willesden in course of time, but the trouble, evidently, is not over yet. Chelsea Debenture stock is quoted *ex* dividend, and if we add the distribution to the price, a rise of ¼ is the result. Which, after all, is something to be thankful for. Blackheath and Greenwich Ordinary are ⅝—1. Bournemouth and Poole are quoted at 12 to 13, *ex* the right of application for the new shares, and the Preference are 10 to 11, also *ex* rights. Calcutta Electricity keep firm at 6⅝, and Oxfords are nominally 7.

In the telegraph market the principal fall has occurred in Eastern Ordinary, and the drop was accelerated by the news of the fourth breakdown of the South African cable since the commencement of the war. "Chinas" are duller, but have not suffered to the same extent in proportion to Easterns. The American stocks are flat, owing to the financial crisis in New York. All the official bolstering up of credit was, after all, unable to stay a panic in which money has been lent, within the last few days, at the rate of nearly 200 per cent. per annum. Brazil Subs. are *ex* a dividend of 3s. per share, and allowing for this, the price has only relapsed 2s. The Trust Company's stocks have suffered, Globe Telegraph Preference the most heavily, owing to a persistent effort to sell shares in a flat market. Nothing is now said about the new cable; in fact, all new enterprise, for the time being, is completely at a standstill. National Telephones are weak, the Ordinary shares being now quoted at par (£5), and the Third Preference have also declined.

In the traction market the electric railway stocks have fallen all round. Central London Ordinary and Deferred half shares are each ½ down. City and South London Ordinary has lost 2, and Waterloo and City, 1 point. For these changes the crash in Consols is mainly responsible, it having caused a serious tumble in home rails generally, electrics proving no exception. British Electric Traction have been offered at 15½ without finding buyers. The dealers declare that they have more shares on their books than they want as it is. Anglo-Argentine trams are 3⅞; Blackwood and Fleetwood, 18; and the new Tramway's Union keep in the neighbourhood of 30s. Potteries Electric Traction are 12, the Preference, 10 to 11.

This is no time for selling. In many cases prices are at the lowest level of the year, and investors are growing frightened as they see their securities dwindle away in price day after day. They rush in to sell, and by their action only accentuate the weakness of the market and obtain a most unsatisfactory price themselves. It must be remembered that the Transvaal war does not affect the carrying power of an electric railway in this kingdom; it has a good effect upon telegraph companies; it influences only to a very small, very indirect degree, the profits of an electric supply company. The best thing that can be done now is to "see the thing through," if the investor's list is made up of sound stocks. Prices may go lower yet. We are inclined to think that they will before the New Year is with us, but there is no cause for alarm to genuine holders of solid securities, and they should not for a moment entertain the thought of sacrificing their stocks at such a critical time, when six months hence will probably see a very different complexion upon everything.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Dec. 13th.	Closing Quotation, Dec. 20th.	Business done during week ended Dec. 20th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	65 — 68	63 — 66	65	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115½ —116½	113 —115	116	113½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	16⅜ — 17⅛	15⅛ — 16	16⅞	15⅜
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14⅜ — 15⅛	14⅛ — 14⅜xd	...	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	198 —202	198 —202	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	103⅝	102
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛ — ¼	⅛ — ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	8½ — 9½	8½ — 9½	9 5/16	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	11⅜ — 12¼	11⅜ — 12¼	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	150 —155	145 —150	154	145
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	98 —101	98 —101	100	99⅜
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	116	115½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15 — 15½	14⅜ — 15¼	15	14⅛
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	121	116
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	101	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	101 —104%	101—104%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11¼ — 11⅜	10⅜ — 11½	11⅜	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15⅛ — 15⅜	14⅜ — 15¼	15⅜	14⅜
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31 — 33	31 — 33	31¼	...
86,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	⅛ — ⅜	⅛ — ⅜	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅝ — 1	⅝ — 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5¼	5 — 5¼	5	4⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5¼	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	101	100⅜
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝ — 1	⅝ — 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	102 —105	102 —105	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	126 —131	125 —130	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜ — 5¼	4⅜ — 5¼	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	105½	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	98	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛ — 1	⅛ — 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	⅞ %	...	⅞ — 1⅛	⅞ — 1⅛	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	9¼ — 9⅝	9¼ — 9⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	7⅛ — 8½	7⅛ — 8½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	106 —109	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7⅛ — 8½	7⅛ — 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	9⅛ — 10⅛	10	9⅜
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9⅛ — 10⅛	9⅛ — 10⅛	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜ — 6¼	5⅜ — 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½ — 8½	7½ — 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	111 —113	109 —111 xd	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	10 — 11	11¼	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	126¼	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	111 — 114	110 —113	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	4⅜ — 5¼	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	2¾ — 3	2¼ — 2⅜	2⅜	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	5⅜ — 6¼	5⅛ — 6	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	102 —104 xd	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	13½ — 14½	13 — 14	14⅛	13 1/16
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	13½ — 14½	13 — 14	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½ — 16½	15½ — 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15½ — 16½	15 — 16	15½	...
30,000	Do. do. 7 % Pref., 30,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4¼ — 4⅜	4¼ — 4⅜	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14 — 15	13½ — 14½	13½	13¼

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid.
‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years.			Closing Quotation Dec. 13th.	Closing Quotation Dec. 20th.	Business done during week ended Dec. 20th, 1899.	
			1896.	1897.	1898.			Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3¼	2⅜— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	16½— 17	15 — 16	15⅝	15⅛
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13 — 13⅛	12⅝— 13¼	13 5/16	13
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	125 —128	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½— 12⅝	11¼— 12⅛	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Engine., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅜— 2⅝	2⅛— 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13 — 14	12½— 13½	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	9⅜— 10¼	10 7/16	10¼
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4½— 5	5	...
71,447	Do. do. Def. do.	5	...	...	...	5¼— 5⅜	4⅞— 5	5⅜	...
630,000£	City and South London Railway	Stock	1 9/16%	1⅞%	2⅛%	61 — 64	59 — 62	62	61
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	4½	...	...	...	3½— 4½	3½— 4½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛%	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛%	6 %	6 %	3½— 4⅛	3½— 4⅛	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3⅛	2⅜— 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 12	10 — 12	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	12 — 13	12 — 13	...	...
15,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	5 — 5⅛	5 — 5⅛	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	3½%	3½%	8 15/16— 9 1/16	8⅛— 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13⅜	13¼— 13⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	36 — 40	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9 — 10	9 — 10	9⅜	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	100 —103	...	...

† Quotations on Liverpool Stock Exchange.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, 5/16—5/16.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10—11.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½ xd.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 6 per cent. (November 30th, 1899).

MARKET QUOTATIONS, Wednesday, December 20th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	£29	..
a „ „	per ton	£27	£27	..
a Bleaching powder	per ton	£6 1	£6 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
c „ (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£25	£25	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4½d.	4½d.	½d. inc.
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	63/-	63/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	3½d.	3½d.	..

METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
„ Sheet, in ton lots..	per ton	£191	£191	..
Babbitt's metal ingots	per ton	£70 to £125	£90 to £160	dec.
Brass (rolled metal 2' to 12') basis	per lb.	8d.	8d.	..
e „ Tube (brazed)	per lb.	10d.	10d.	..
„ Wire, basis	per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£85	£86	..
g „ Wire (basis price) ..	per lb.	10½d.	10½d.	..
g „ Sheet	per ton	£95	£95	..
g „ Rod	per ton	£85	£85	..
a German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	7/-	7/-	..
h India-rubber, Para fine ..	per lb.	4/6½ to 4/7½	4/6½ to 4/7½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	64/6	66/8	1/10 dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£17 10	£17 10	..
g „ „ Sheet	per ton	£19	£19	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 12 6	..
d Mica (in original cases), small	per lb.	2d. to 8d.	2d. to 8d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large	per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/1¼	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet	per lb.	From 1/2¼	From 1/3½	..
o Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£38	£38	..
g Tin, block	per ton	£124 5 nom.	£124 5 nom.	..
g „ foil	per lb.	1/7	1/7	..
n „ wire Nos. 1 to 16	per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	7¾d.	7¾d.	..
j „ Best Flax, 6 lea. ..	per lb.	5d.	5d.	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£24 3 nett.	£25	15s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. F. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

METHODS OF SUPPRESSING ARCS IN SWITCHES, FUSES, &c.

By Ernest Kilburn Scott, A.M.I.C.E.

(*Read at Manchester, Tuesday, December 5th.*)

(*Continued from page* 982.)

Choking Coil on Alternate-Current Switches.—Regulating switches for alternating current have not been required to any great extent hitherto, but the introduction of the regulating booster transformer, and of traction by multiphase motors, has shown the necessity for protecting alternating current switch contacts from excessive arcing. The method of reducing arcing by a double brush and small resistance on continuous current accumulator charge and discharge switches is well known. In much the same way alternating current regulating switches may be easily and cheaply fitted with a small choking coil, which automatically comes into circuit by means of a double brush at each jump from contact to contact, annihilating arcing as effectively

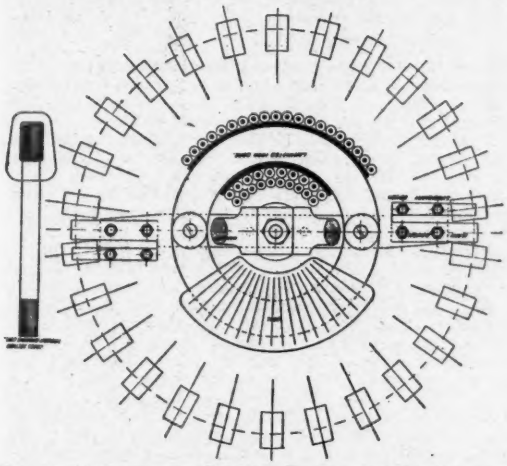


Fig. 12.—Alternating Current Regulating Switch, with Choking Coil.

as does the magnetic blow-out. The small resistance used in continuous current regulating switches is not nearly so effective as the choking coil in the alternating current switch, because of the latter having a mass of soft iron entering into its construction. Fig. 12 shows the arrangement of such a switch for a booster transformer.

Use of Electrolytic Cells.—It is interesting to note that part of an alternating current wave may be suppressed by the employment of electrolytic cells. M. Adolph Müller, of Hagen, Germany, has been carrying out some work on these lines, and he advocates a method of preventing sparking on making and breaking circuits by the employment of electrolytic or polarisation cells.

As arranged for continuous current circuits, say for switching off arc lamps, a number of elements consisting of aluminium plates immersed in an alum solution are first switched into circuit, see fig. 12a, by moving the switch lever H in the direction of the arrow so as

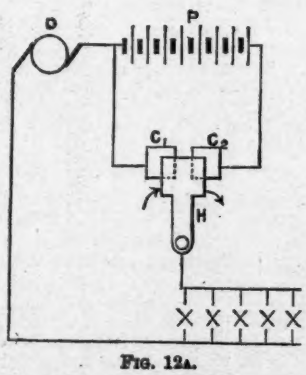


Fig. 12a.

to connect up the two contacts, c_1 and c_2. As soon as the lever touches contact c_2 the battery P is polarised to the terminal tension of the current source D. Current is thereby reduced to zero, thus permitting the circuit to be broken *without* sparking.*

The arrangement can be used for interrupting or breaking alternating currents, the polarisation batteries being made of small capacity, so that the condition of their charge can follow the change in the E.M.F. of the current source quickly enough to at any moment bring the sum of the latter and of the opposing E.M.F. of the consumption apparatus to zero, thereby stopping flow of current. The idea can be applied to stop sparking on a commutator operating synchronously with an alternating current, as in the Ferranti rectifier. In alternating current work the polarisation battery could be replaced by a condenser, but it would hardly be as mechanically reliable as the battery.

The cells may be made up of steel plates immersed in potash lye, or simply lead plates in sulphuric acid.

This, and, to some extent, the choking coil method just mentioned, are especially interesting, because the idea is to prevent an arc *forming*, whereas in all other cases we have so far considered the arc first forms and is then suppressed.

In this connection it may be of interest to briefly refer to several methods of preventing arcing in continuous current circuits which surround an iron core.

When a dynamo or alternator field winding is switched off, the magnetisation at once begins to weaken, and the change in the number of magnetic lines induces an E.M.F. tending to maintain the current in the same direction, and at the same strength as before. This induced E.M.F. may be many times greater than the working pressure, and so be liable to pierce the insulation; it is therefore the practice in shunt wound dynamos, particularly, to short circuit the field winding through a resistance (sometimes only the armature and a group of lamps) when shutting down. In this way current continues to flow through the coil in the same direction, and the demagnetisation being thus delayed, the induced E.M.F. is reduced within safe limits.

The flash on opening a field magnet circuit may be much reduced by building the coil on a sheet copper-former, the copper making electrical connection all round the pole. This method was used on some of the first arc lighting machines built in this country.

Another most effective method of preventing arcing under such circumstances has been recently introduced by Messrs. C. L. Buckingham and E. Germann. They merely wind on the various layers of the coil in one direction only, that is to say, each layer starts from the same end of the former. In telegraphy it has been known for some time that sparking at the key of a local telegraph circuit can be lessened by winding the electro-magnet with two wires connected in parallel. Buckingham and Germann's method is a development of this idea, and the beneficial result is most probably due to a condenser action between adjacent layers at different potentials, the electrostatic charges from which balance, to a certain extent, the self-induction. Destructive arcing being prevented by this means, it follows that there is much less liability of the insulation being pierced.

Part II.—Fuses.

Fuses, and especially switch fuses, which have recently come so much into use, form a distinct class of apparatus, and a few remarks thereon may be of interest.

Mordey Dust Fuse.—It is an axiom in the construction of high tension fuses, that both from the point of view of safety in handling, and also in order to ensure blowing at the right moment, the wire must be enclosed. It is obvious, however, that the mere enclosing of the wire in a straight tube with a terminal at either end is not going to destroy the arc unless made of unreasonable length, and principally with the idea of reducing this length, Mr. Mordey, in 1890, suggested his well-known *dust fuse*. In this fuse the wire is completely enclosed

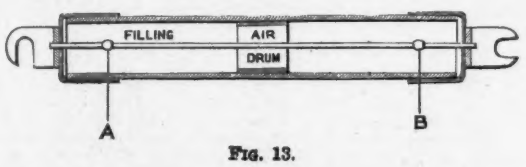


Fig. 13.

in a glass tube, and passes through a marble dust and sand, cement at each end, this refractory insulating filling preventing the arc travelling outwards to the contacts and absorbing the volatilised metal. For large currents it is used as a shunt to an ordinary fuse, the arrangement being such that the final break occurs between the two pallets of marble dust.

The Berend Switch Fuse consists of a long *papier-mâché* tube about 1½ inches in diameter, ⅛ inch thick, and 12 inches long for 4,000 volts. It is fitted at each end with gun-metal hatchet contact pieces to which the fuse wire is soldered. Before placing in position the tube is filled up with sand, the *papier-mâché* tube being perforated in several places, and the holes covered with tissue paper, so that when the fuse blows the paper is charred and serves to draw the attention of the attendant. To re-fuse, the metal ends are unscrewed and a new wire soldered to them. When the fuse blows, it is probable that as the vaporised

* Some few years ago Prof. Perry suggested the use of lead plates in dilute sulphuric acid in connection with two parts of a brush to prevent sparking on dynamo commutators. Something of the same sort was also suggested in connection with the experimental line at Wolverhampton on the Wynne surface contact system of traction.

metal is many times greater than the volume of the fuse, there is a powerful tendency for the vapour to rush out from the space originally occupied by the fuse wire. The sand being porous, the vapour therefore easily penetrates it, and dividing up into numerous small streams of vaporised metal, the desired effect of breaking up the vapour is effected.

The reliability of the fuse would probably be increased if it had an air space round the wire at the centre, as in the Mordey fuse. Being closely surrounded along its whole length, its maximum carrying capacity is liable to change according to the length of time the fuse is in circuit, gradually becoming less as the surrounding material is heated. Obviously, a fuse which, when hot, would be a protection, is not so efficient a protection when cold. The use of an air chamber modifies this defect, because the confined air is so much less a conductor of heat than is the sand filling.

The D. and W. Fuse—a similar arrangement to Mordey's—is a good deal used in America, and has recently been adopted on the Central London Railway plant. It is shown in fig. 13. The wire is soldered to copper terminals at A and B, and an air space is formed in the centre by a little paper drum or capsule, which thus ensures the fuse wire first going at the centre, the confined air being a much poorer conductor of heat than the filling. The makers have accumulated a large amount of practical data, showing the connection which the rise in temperature bears to the current value, and thus, although the fuse can hardly be called novel, they undoubtedly turn out a properly rated and reliable piece of apparatus.

The Bates High Tension Switch Fuse has the fusible wire passing through an open-ended fireclay tube about ⅝ inch inside diameter, carried in a porcelain handle fitted with hatchet contacts as shown in fig. 14. When the wire melts the heated air escapes with con-

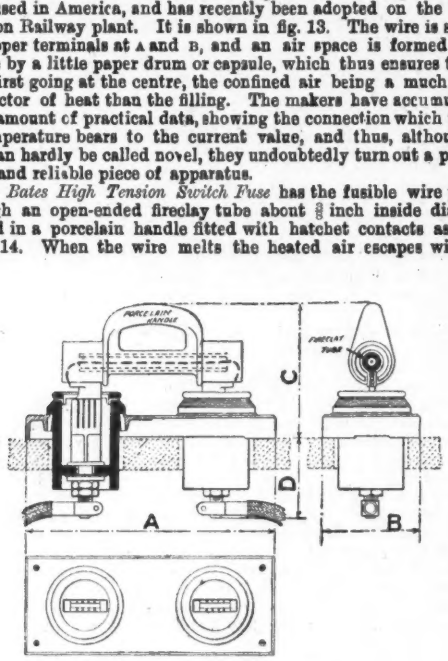


Fig. 14.—Bates Switch Fuse.

siderable velocity at either end and so splits the arc in two. A Mr. G. F. Curtiss suggested using an open ended fuse in America as early as March, 1891, and those who visited Switzerland recently will have noticed that the same idea is very extensively employed there.

The Fowler (Hall and Fuller) Switch Fuse has a porcelain handle similar to the above, but each fuse wire is in this case closely surrounded by two lengths of asbestos sheathing, the whole being further protected by a glass tube. The fuse wire is placed in the

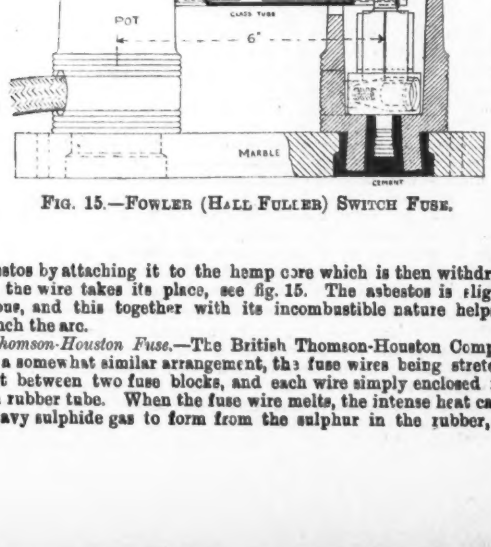


Fig. 15.—Fowler (Hall Fuller) Switch Fuse.

asbestos by attaching it to the hemp core which is then withdrawn and the wire takes its place, see fig. 15. The asbestos is slightly porous, and this together with its incombustible nature helps to quench the arc.

Thomson-Houston Fuse.—The British Thomson-Houston Company use a somewhat similar arrangement, the fuse wires being stretched tight between two fuse blocks, and each wire simply enclosed in a thin rubber tube. When the fuse wire melts, the intense heat causes a heavy sulphide gas to form from the sulphur in the rubber, and this reduces the arc. Although the wires are entirely out of sight the smell is sufficient to indicate where they have melted. This fuse has been used by the City of London Company for some time, and is well spoken of.

(To be continued.)

ALUMINIUM AND ITS USES AND TREATMENT IN ELECTRICAL ENGINEERING.*

By J. H. HENDERSON.

In the first place, I have to say that although the substances from which aluminium is extracted are widely diffused in nature and are in great abundance, it is only the last 10 years that have seen commercial and industrial success in the extraction of it from them.

The agent which has produced this success is electricity—the electrolytic extraction of it from its ores. This is how electrolysis produces it (by one successful method):—

In a metal carbon-lined crucible having two carbon electrodes, one of which acts as anode and the other as cathode, are put the following ingredients:—

Fluoride of calcium ...	...	234 parts by weight.
Double fluoride of cryolite	...	421 "
Fluoride of aluminium ...	...	845 "

To these add 3 to 4 per cent. of a suitable chloride; for example, calcium chloride. To this add alumina sufficient to form a very stiff mixture.

Before electrolysis can begin the above are fused by means of heat, which should not exceed 1,210° F. The heat is obtained from a furnace heated by gas, coke, or charcoal, care being taken that no gases from the furnace enter the crucible. The bath fused, the electrodes are dipped into it, the current switched on, and the metal is gradually deposited at the rate of 1 lb. of metal (in the best and largest of the crucibles) per 5 E.H.P.-hours.

The pressure required is 6 to 8 volts at a current density of 1½ amperes per square inch. The metal from time to time is removed from the crucible by means of a siphon or a ladle, care being taken to remove as little of the haloid salts as possible. There is another method of extraction, equally successful, but also more economical.

In this other method a set of similar ingredients are placed in a crucible having one or more vertically movable carbon electrodes, which are used as one or a collective anode respectively. The crucible, though lined principally with carbon, has some metal exposed to act as a cathode at the beginning of the process, this is to generate heat enough to fuse the bath, after which the anode is placed so that the extracted aluminium acts as a cathode. The molten metal is from time to time run out of a tap hole into a mould, and thence cast into ingots, or granulated by being poured into cold water. The same particulars as to results apply to this crucible furnace process also, except that not nearly so much of the bath is wasted in it, and the metal needs less purifying when molten. There is also no loss of time and money from the use of gas, coke, or charcoal, and of an extra furnace in this method.

Peculiarities of Aluminium as an Electrical Conductor.

There is first its lightness. It is, roughly speaking, about three times lighter than copper. By way of illustration: if a given diameter of copper wire weigh 1 cwt. and a certain length the same diameter of aluminium wire weigh 1 cwt., it will be found upon measurement being made that the aluminium wire is just over three times the length of the copper wire.

Aluminium is not so Good a Conductor as Copper.

Using the above illustration it would require nearly two-thirds of the aluminium wire to be melted up again and drawn into wire having the same length as the copper wire, but a very much greater diameter than the copper wire to give the same conductivity as the copper wire.

Its Incorrodibility.

Aluminium is incorrodible indoors. It is almost incorrodible in the outside atmosphere. When exposed to moist air a slight harmless oxide of alumina is formed, discolouring it a little, but protecting it from further corrosion. Steam and flue gases, ammoniacal vapours, any of the acids, strong or dilute (except hydrochloric acid slightly), do not affect it in any way; the alkalies alone affect it, hot caustic soda solution dissolving it very quickly.

Tensile Strength.

Its tensile strength is a little less than that of copper, diameter and length being equal; but weight for weight, aluminium has nearly three times the tensile strength of copper.

Its Use as an Insulated and Bare Conductor.

It is being largely used by American electrical engineers as a bare and insulated conductor for telephone and telegraph wires, and for power, &c. It is now being used as a trolley wire, and the British Aluminium Company are showing such a wire very neatly made and jointed with their soldering method. It is also being largely used by electrical firms for commutators on account of its

* Abstract of a paper read before the Manchester Junior Electrical Engineers, held at the Deansgate Hotel on Tuesday evening, November 28th, 1899.

light weight and non-magnetic and non-sparking properties and for brushes and brush holders, switches and cut-outs for the same reason.

Aluminium in the Foundry.

Now about the peculiarities of aluminium in the workshop and the foundry. In the foundry very much larger runners and risers and gates must be used than for brass casting, and plenty of vents must be made in the moulds to let out the gases; as also in sand moulding, the mould must be rammed very loosely—the metal shrinks very much more than brass does—hence the need of the above. Also the nearer the metal is kept to 1,210° F. in melting, and the nearer it is allowed to cool down to a dull red heat before being poured, the whiter and more smooth will be the casting. Aluminium also makes certain good alloys, and is itself alloyed in very small percentages with steel and iron to ensure easy melting and sound, close-grained castings.

The Workshop.

In the workshop special precautions have likewise to be taken. In soldering, great cleanliness and absence of sootiness, a special solder and flux, and a nickel bit have to be used. The British Aluminium Company supply the solder and the flux. Good contact is also made by twist joints, screw joints, and riveted joints.

In turning the pure metal, the lathe has to be run at a high speed, and light cuts have to be taken with tools shaped pretty much as those for hard wood are shaped, the work being lubricated the while with a solution of stearic acid and turpentine. In filing the pure metal single-cut files have to be used to prevent choking. Stamping and pressing is done as in brass, annealing the metal from time to time. In engraving, coat the plate with stearic acid dissolved in turpentine to prevent slipping of the graver. In polishing, use a mixture of tallow and flour emery; for the finish gloss, use a mixture of rouge and turpentine and separate buffs, &c. In rolling and drawing, the only requirement is annealing at a very low red heat and plunging into cold water from time to time.

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting on Tuesday, December 12th, Sir Douglas Fox, president, in the chair, the paper read was on "Combined Refuse Destructors and Power Plants," by Mr. C. Newton Russell, Assoc.M.Inst.C.E.

The paper dealt with the subject of refuse destruction, particularly in reference to its employment for raising steam, and gave details of 10 combined plants, the data of which all tended to prove that a considerable amount of energy in the form of heat was to be obtained from the burning of ordinary domestic refuse. The results obtained from eight combined plants in England and two abroad were given, the Shoreditch plant being dealt with in considerable detail, as being the largest of its kind in operation.

The total amount of refuse destroyed during a period of 12 months was about 26,000 tons, of which 92 per cent. was ordinary house refuse, and 8 per cent. trade refuse, consisting of straw, paper, &c. The latter was practically useless for steam raising. The plant consisted of six Babcock-Wilcox water-tube boilers and 12 refuse furnaces of the Manlove-Alliott type, each boiler being placed between two refuse furnaces, the hot gases from which were led into the boiler tubes through short side flues, each boiler being provided with a special grate, on which coal might be burned if required. The refuse, on arrival at the works, was carefully weighed, and was afterwards shot, without sorting, into trucks which were raised by electric lifts (of which there were two) to the top platform. On arrival at this point the truck, which was on wheels, and fitted with an electric motor, was run off the lift on the overhead trolley system, to any position where it was desired to empty it; the refuse was then tipped into special charging trucks, one of which was provided for each furnace, and which was operated from the top platform by means of chain gearing. The average amount of refuse received per day was 84 tons, delivered between 9 a.m. and 5 p.m., although as much as 140 tons had been received in one day. It appeared to be impossible, in ordinary working, to guarantee a regular supply, and it was advisable to provide means of storage to cope with extra large deliveries. This difficulty was met at Shoreditch by means of a large rectangular iron storage bin fixed under the tipping platform, and holding about 60 tons of refuse. The lifts and trucks were operated entirely by electricity. Forced air draught was supplied to the fires by electrically-driven fans, the pressure in the ashpits being 1 inch of water. No coal or other fuel was mixed with the refuse, which burnt freely; the maximum temperature observed being 2,500° F., and the average, 1,500° F. Considerable inconvenience was experienced owing to cold air rushing into flues during clinkering operations, the trouble being, to a great extent, unavoidable, and called for a perfect system of dampers. The clinker residue amounted to 32 per cent., and was at present difficult to dispose of, owing to the cartage from works to the outskirts of the town being high. The clinker was suitable for making mortar concrete, and, when ground and mixed with Portland cement, made excellent paving slabs. The works were managed on the 8-hour shift system, 7 days per week. The feed water for the boilers was drawn cold from storage tanks by three-throw pumps, which forced it through economisers placed in the main flues, where it was raised to a temperature of about 200° F., depending upon the heat of the flue gases and condition of economiser. The water was then forced upwards into a large feed water storage cylinder, 30 feet by 8 feet, fixed about 20 feet above the boilers, and was connected direct to the main steam line, and which was, therefore, at the same temperature and pressure as the boilers, which were fed directly from this cylinder by gravity, the water flowing into the boilers freely without any strain or racking action on the check valves. The steam generated in the boilers, at an average pressure of 140 lbs. per square inch, was disposed of mainly by the engines attached to the electric generators, although a small portion of live steam was supplied for clothes-washing purposes to the public baths and wash-houses adjoining the electricity works; exhaust steam was also supplied to the baths and free library, which were entirely heated from the steam raised by the refuse destructor.

The average cost of burning the refuse during the second year of working, including four furnace men, two top men and one charge man, supervision clerks, &c., cleaners and yard men, repairs, stores and sundries, was 2s. 6·9d. per ton. The amount of electric energy absorbed in dealing with the refuse, including electric fans, lifts, trucks and lighting, was 4·98 Board of Trade units per ton per annum. A number of evaporative tests had been taken with the result that with one boiler and two refuse furnaces it was possible, by the burning of ordinary refuse, to evaporate 2,888 lbs. of water per hour, from and at 212° F.

The average calorific value of various tests was 0·99 lb. of water per lb. of refuse. The heating surface of each boiler was 1,300 square feet; the refuse grate area was 25 square feet, and the coal grate area was 27 square feet. The total amount of energy sold by meter to consumers was 1,031,348 Board of Trade units, including 131,140 units supplied to the refuse destructor. The total amount of refuse burnt was 26,201 tons, and of coal consumed 1,344 tons (value £1,308 14s. 8d.). The item of cost per ton for interest and redemption of land and plant—not usually considered in connection with refuse destructors—was a matter for serious consideration, and in the case of the Shoreditch destructor plant—where land is very expensive—the charge worked out at practically 1s. per ton.

A REVERSIBLE GAS ENGINE.

Some few months ago, when discussing the question of gas engines, we wrote that while we fully believed in the gas engine as a thermodynamic machine of considerably greater efficiency than steam plant yet it lacked certain features which made the steam engine *facile princeps* of prime movers in its convenience of handling. Our attention has since been drawn to a recently patented engine in which means have been adopted for securing the convenience and ease in handling that is now possessed by the steam engine. The patentees of this new engine, Messrs. Fraser and Macdonald, both practical engineers and fully alive to the shortcomings of the gas engine, have recognised that the feature which ensures the mobility of the steam engine is a stored surplus of energy behind it. The steam engine does not work from hand to mouth. The coal that is being consumed one minute in the furnace is furnishing the energy that will drive the engine in half an hour's time it may be. But in a gas engine fuel is put into the furnace and converted into power within a small fraction of a second. There is no store of energy, and there can be none of that mobility of the steam engine which enables it to stop, make a half revolution astern, stop again and go ahead a moment and generally obey its driver with certainty and promptitude.

Messrs. Fraser and Macdonald have met this difficulty by storing up a part of the energy of each stroke in the form of compressed air. The simple idea is to combine the engine with an air pump to force air into a receiver capable of holding sufficient air to supply several strokes of the engine, the compression of the air raising its temperature sufficiently to heat or vaporise oil where oil is the fuel used, or the temperature may be kept down in the usual way when desired.

The gas supply would be pumped at a pressure greater than the air pressure into a reservoir whence it would be admitted to the working cylinder by valves worked by the same ordinary valve gear which admits the air.

For large powers the air pump would obviously be best driven by an auxiliary engine of constant rotation in a uniform direction. In general the engine would be designed probably of the double acting type, being so arranged as to have an explosion as often as desirable and the limits of practical temperature will allow of the other strokes, if any, being performed by air pressure alone. In this way an economy may be secured. Working by compressed air is not usually an economy, but may be made so where the working air is heated by surplus heat that must otherwise be dissipated in the wasteful but necessary water jacket. These air charges are both cooling and scavenging in their action. The following is the cycle of this engine:—

1. Air admission at, say, 75 lbs. pressure for ·2 of the stroke together with gas, the mixture being exploded by electric spark or by ignition tube suitably uncovered by the piston.

2. The exhaust opens as the crank turns the centre. These operations are repeated. When using compressed air on alternate strokes the above two operations are followed by

3. Pure compressed air is admitted for ·2 of the stroke and

4. Is expanded and drives the piston and exhausts as in 2. In the oil engine the exhaust gases would be led through a regenerative heater into which the oil would be admitted with sufficient air to suitably dilute it, the air charge would thus be treated and the oil vaporised by simple spraying into the hot air.

For reversing purposes ordinary forms of valve gear are employed such as cam shafts with two sets of cams, one for forward and one for backward running. The cams are brought to bear upon the various valves for forward or backward movements. Thus to reverse the engine the following cycle of operations is all that is necessary:—

(*a*) Gas supply shut off.
(*b*) Reversing lever brought over to back-gear position. This of course stops and reverses the engine under air pressure, and as soon as reversing is accomplished
(*c*) Put the reverse lever to its former position, when the cams which formerly drove it forward will of course equally send it backwards, gas being admitted again at the same time. In effect this accomplishes for large engines what is done for small engines by simply stopping them and giving them a turn by hand in the opposite direction, when they will run equally well. But one cannot thus stop and reverse a large engine. The store of air does this and keeps up the rotation until duty is again taken up by the admitted gas.

It is hoped to interest capital to perfect the engine and place it on the market.

ELECTRICAL TIME SERVICE.

The paper on this subject, which was read before the Institution of Electrical Engineers by Mr. F. Hope-Jones on Thursday last week, while in itself interesting, appears to us to be better fitted for the Society of Arts or the Horological Institute; although electricity stands alone in its applicability to the "distribution of time," but a very small percentage of the members of the Institution is likely to be concerned in its use for that purpose, or to possess sufficient experience therein to be able to discuss the details of the apparatus employed with advantage.

The paper commences with a summary of previous work in connection with electric clocks since their original inception by Alexander Bain in 1837. Electric clocks are divided into two classes:—(1) Independent, self-contained, self-wound clocks; (2) Systems of clocks connected together by a line and controlled by a master clock. Class (1) is very briefly dealt with, the author remarking that though hundreds of patents have been applied for in this connection, they are of little use, except when applied to electricity meters.

Turning to Class (2), methods of controlling pendulums by means of momentary currents transmitted at intervals of one second and acting directly on the bobs are touched upon, but are shown to fail

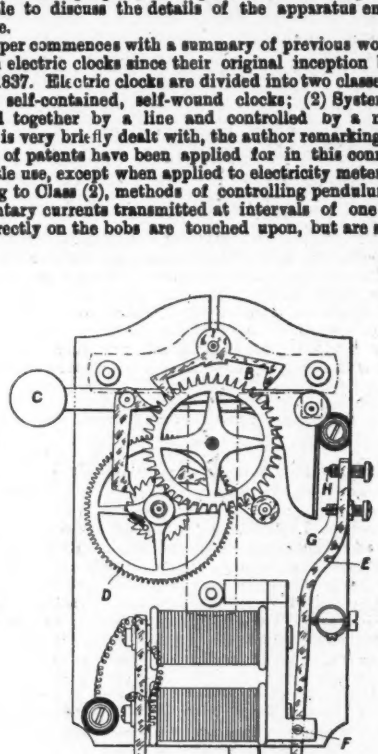


Fig. 1.

in practice. Sometimes, indeed, if the synchronising currents fail for a few beats, when re-established they may be so far out of phase as to oppose the swing of the pendulum and stop it altogether!

Devices which set the minute hand right once every hour are numerous, and one of these, due to Lund, is in operation at the present time in the hands of the Standard Time Company, Limited. In all these cases the complete key-wound clock is retained, and the author pertinently asks: Why use the line only once an hour, instead of using it every minute, or oftener, to directly propel the hands? By this means the clockworks and the necessity of winding up may be dispensed with.

Curiously enough, it is found that the most difficult problem to be solved is that of rotating pointers synchronously by means of periodic currents. A long list of names of inventors is given who have devised time "counters" on this principle, but none of these has attained commercial success. Further, the difficulty of ensuring reliable contacts has been a stumbling block; to avoid this Sir Charles Wheatstone, in 1840, employed a controlling clock, the pendulum bob of which generated alternating currents, which were conveyed to the line by flexible connections and actuated rotating magnets in the subsidiary clocks. Thus there are no variable contacts in the circuit, no battery is needed, and one would suppose the system perfect; unfortunately, however, the functions of time-keeper and magneto-electric generator were found to be incompatible. Similar methods have been put into practical use more recently, and models of these were exhibited at the meeting. Of electrical contact-making devices, the author considers those invented by Mr. T. J. Murday, and used in the Johnson and Phillips integrating meter, to be the best; a description of one form is given, with a figure.

For his own part, the author favours step-by-step dials operated by a central clock, and has directed his attention to ensuring certainty of contact and improving the dial movement. His master-clock, which is electrically driven, transmits a current every half minute to the dependent dials; the mechanism of the former is illustrated by fig. 1.

The pendulum, A, is driven by an escapement, B, in the usual way, the turning force being derived from a weighted lever, C, by means of a click and ratchet. E is an armature centred at F; as the lever falls driving the pendulum, its lower limb makes contact with the screw, G, in the tail of the armature, the circuit of the electro-magnet and of the dials in series with it is closed, and the armature is attracted. The weight is therefore thrown up, while the insulated screw, H, comes in contact with the lever, and the circuit through G is sharply broken.

The author claims for this apparatus the advantage that the whole of the energy required to drive the pendulum for half a minute is mechanically transmitted through the contact surfaces at each operation, and attributes to this feature the fact that he has never known one of these contacts to fail, out of hundreds that have been in use for years. Further, the driving power is absolutely constant.

Fig. 2 shows the movement of the dials controlled by the master-clock, and practically explains itself. The special features of this

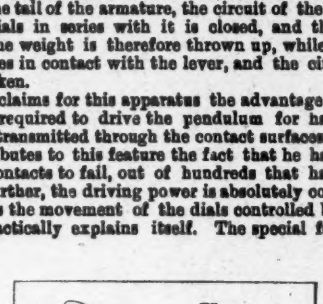


Fig. 2.

device are the use of rectangular teeth, an impulse click which is not tangential to the rim of the wheel, and a backstop click which works close behind the impulse click. Jamming and overthrowing are alike prevented, and extreme accuracy of workmanship is rendered unnecessary.

The use of relays for the driving of large turret clocks is described, and it is pointed out that even for independent clocks of this type it is better to use a small master-clock and electrical driving than to incur the much greater expense of the ordinary turret-clock movement.

An interesting experiment was exhibited, in which a number of dials were placed in series with a vibratory interrupter making 25 vibrations per second; even at this high frequency the dials kept perfectly in step!

The paper concludes with a discussion of the uses to which the system can be applied, and watchman's watchers in factories, speed recorders in engine rooms, school bells, automatic arc lamp switches, &c., are instanced, none of which, in our opinion, is at all likely to make use of it. The author's optimistic expectation that 50 per cent. of the offices in "a busy district of the city" will instal the dials, seems equally over-sanguine.

One drawback to the system, we think, is the *series* connection adopted by the author; true, he advocates very good work in the transmission lines, but with "from 50 to 100" instruments in series, the possibilities of interruption are far too numerous for a public service which, of all things, must be *absolutely reliable*. It is bad enough that now and then a public clock should go wrong, but the stoppage, even for 10 minutes, of all the public clocks in a district would be nothing short of disastrous.

Finally, we think that the author's summons to the electrical engineering profession, to bring about the establishment of a public time service, like his paper, should have been addressed to the Horological Institution.

Light Railways.—It is stated that the applications made to the Light Railway Commissioners in November for orders authorising light railways in England are for a total mileage of 433¾, nearly the whole of which it is intended to work by electricity.

THE COMMITTEE ON COPPER CONDUCTORS.

We have received from Mr. A. H. Howard, the secretary of the above Committee, a copy of its report, which we reproduce below:—

The advantages of standardising are being largely advocated for almost all classes of engineering products, but copper conductors have hitherto not been included in the list, as everyone has assumed that they were already standardised, and that Matthiessen had settled the resistance and temperature coefficient of copper in his researches nearly 40 years ago.

This assumption is far from being true, and the catalogues of various electrical cable makers, as published before 1899, show considerable discrepancies in the resistance and weight of nominally the same cables, while the Post Office issued a specification differing from all the others.

In order to remedy this confusion, a committee was formed of those interested to determine a standard, and the Institution of Electrical Engineers, the General Post Office, and the principal manufacturers of rubber insulated cables, sent representatives. Meetings were held early in 1899, and the report given below was adopted by the following delegates:—

Sir W. H. Preece, K.C.B., F.R.S., *chairman*, Mr. J Gavey, Mr. H. Hartnell (for the General Post Office); Prof. W. E. Ayrton, F.R.S., Mr. W. M. Mordey, Mr. Herbert A. Taylor (for the Institution of Electrical Engineers); Mr. J. W. Connolly (Connolly Bros., Limited); Mr. R. J. Hatton (Henley's Telegraph Works, Limited); Mr. W. E. Gray (India-Rubber, Gutta-Percha, and Telegraph Works, Limited); Mr. A. Paterson (Johnson & Phillips); Mr. F. Jacob, Mr. J. S. Huddlestone (Siemens Bros., Limited); Mr. A. H. Howard (W. T. Glover & Co., Limited.) The Telegraph Manufacturing Company, Limited, and the London Electric Wire Company, Limited, also co-operated in forming the Committee and have adopted its recommendation.

The report of the Committee is as follows: —

1. *Resolved.*—That Matthiessen's standard of 0·153858 standard ohms resistance for a wire 1 metre long weighing 1 gramme at 60° F. be taken as the standard for hard drawn high conductivity commercial copper.

2. Hard drawn copper to be defined as that which will not elongate more than 1 per cent. without fracture.

3. *Resolved.*—That Matthiessen's standard of 0·150822 standard ohms resistance for a wire 1 metre long, weighing 1 gramme at 60° F., be taken as the standard for annealed high conductivity commercial copper.

4. Copper to be taken as weighing 555 lbs. per cubic foot at 60° F., which will give a specific gravity of 8·912.

5. *Resolved.*—That Messrs. Clarke, Forde & Taylor's temperature coefficient as published in their pamphlet dated February 20th, 1899, be adopted, and that the average coefficient of 0·00238 per degree F. be adopted for commercial purposes.

6. *Resolved.*—That the resistance and weight of conductors be calculated from the actual length of the wires.

7. *Resolved.*—That a lay of 20 times the pitch diameter be taken as the standard for the calculation of tables.

8. *Resolved.*—That 2 per cent. variation of resistance or weight be allowed in all conductors.

9. *Resolved.*—That an allowance of 1 per cent. increased resistance as calculated from the diameter, be allowed on all tinned copper between Nos. 22 and 12 gauge inclusive.

Note to 1st and 3rd.

The figures inserted have been calculated for 60° F. from the figures 0·1469 per metre gramme for hard drawn and 0·1440 for annealed at 32° F. by Matthiessen's formula.

$$R\,t^\circ = \frac{R\,32^\circ}{1 - 0{\cdot}0021500\,6\,(t - 32) + 0{\cdot}00000278\,(t - 32)^2}$$

A. H. Howard, *Honorary Secretary.*

From the above data the following formulæ are obtained:—

Solid Wires.

Copper weighs 555 lbs. per cubic foot at 60° F. Specific gravity = 8·912.

The resistance of annealed high-conductivity commercial copper is:—

Resistance per cubic inch, 0·00000066788 standard ohms.
Resistance per cubic cm., 0·00000169639 standard ohms.
Resistance of 100 inches weighing 100 grains, 0·150158 standard ohms.

$$\text{Resistance per mile} = \frac{0{\cdot}042317}{\text{Area in square inches}}$$

$$\text{Resistance per yard} = \frac{0{\cdot}000024044}{\text{Area in square inches}}$$

Resistance per mil-foot = 10·2044 standard ohms.

The resistance of hard-drawn high conductivity commercial copper is:—

Resistance per cubic inch = 0·000000681327 standard ohms.
Resistance per cubic cm. = 0·00000173054 „
Resistance of 100″ weighing 100 grains ... = 0·153181 „

$$\text{Resistance per mile} = \frac{0{\cdot}0431689}{\text{Area in square inches}}$$

$$\text{Resistance per yard} = \frac{0{\cdot}0000245277}{\text{Area in square inches}}$$

Resistance per mil feet = 10·4099 standard ohms.
Weight per mile ... = 2035·1 × area in square inches.
Weight per yard ... = 11·5625 × area in square inches.

Cables.

A lay of 20 times the pitch diameter is adopted as a standard, and the resistance in parallel of the wires is taken as the resistance of the cable.

Resistance of 3-strand cable			= 0·33742	× resistance of each wire,
„	4	„	0·253055	„
„	7	„	0·1443557	„
„	12	„	0·084355	„
„	19	„	0·0532424	„
„	37	„	0·0273493	„
„	61	„	0·0165911	„
„	91	„	0·0111222	„
Weight of 3-strand cable			= 3·03678	× weight of each wire.
„	4	„	4·04904	„
„	7	„	7·07356	„
„	12	„	12·1471	„
„	19	„	19·2207	„
„	37	„	37·4414	„
„	61	„	61·7356	„
„	91	„	92·1034	„

The above formulæ give the standards, but a variation of 2 per cent. in resistance or weight is allowed for losses in manufacture.

These figures have been adopted by all of the parties represented, and it is hoped that they may become the universal standard for Great Britain.

The measurements made by Dr. Matthiessen were for the purpose of determining the best metal to use for a standard resistance, and the permanence of the resistance was of more importance than the actual numerical value.

The specific gravity of the copper was not taken, and as the results are given by length and weight, they afford no means of determining the resistance of a wire of any given diameter. In addition, B.A. units have been confounded with standard ohms, so that discrepancies have arisen from both causes.

The resistance of a stranded conductor varies according to the lay of the wires. Some makers use a lay of 12 times the pitch diameter, while others go so high as 30 times the pitch diameter; 20 was adopted as an average figure, and the resistances calculated from the actual length of the wires, viz., 1·01226 times the length of the cable for all except the centre wire.

As the Post Office specifications will be issued in accordance with the above report, and as all of the manufacturers mentioned will include the same figures in their catalogues, there seems little doubt that these standards will be adopted throughout Great Britain.

THE WORKMEN'S COMPENSATION ACT.

The case of Francis *v.* Turner Bros., which came before the Court of Appeal on Saturday, December 16th, involves the decision of a point which is of the greatest interest and importance to electrical engineers. The question was whether a workman who meets with an accident when employed upon a job away from his master's factory, can claim compensation under the Act. The facts, so far as they are material for our present purpose, were as follows: It seems that the injured man had been sent with other workmen to remove certain machinery from a factory situated at a distance of ½ mile from his employers' premises. While thus employed he met with a serious injury. He subsequently claimed compensation from his own employer on two grounds, (*a*) that he had met with the accident upon premises which were a "factory" within the meaning of the Act, (*b*) because his employer became occupier for the time being. The Court of Appeal declined to adopt either of these arguments, and gave judgment for the defendants who were the respondents in the Court of Appeal. Lord Justice Smith definitely stated the true interpretation of the law to be that the words "*on, in, or about a factory,*" within the meaning of the Act meant the factory of the workman's employer.

This important conclusion confirms the opinion of his Honour Judge Addison in the case of Belsey *v.* Sadler [which was commented on *sub. tit.* "What is a Factory?" in the Electrical Review for October 27th.] In that case the County Court judge decided that a workman injured while erecting an hydraulic crane on premises other than those of his own employer, was not entitled to relief.

To the electrical engineer whose business largely consists of the erection of installations, of lighting private houses, or of laying wires in premises other than his own, this decision cannot fail to have considerable value. Injuries sustained by workmen when thus employed can only be redressed by means of the older and more cumbrous means which are provided by the Employers' Liability Act, or, to go further back, by the common law.

Certain other decisions which have recently been arrived at in the Court of Appeal, also force themselves into a position of considerable prominence, inasmuch as they appear to relieve the employer from liability in a number of cases. Although, as a general rule, the state of the workman's health must not be taken into consideration when the question of the employer's liability to pay compensation is mooted, yet, if the County Court judge finds as a fact that he was suffering from disease, and that his death, or the injury, was primarily caused by that disease, no compensation can be claimed. In a case which was heard last Saturday, for instance, the use of red lead and oil injured

a workman's hand, the same having been rendered receptive by blisters which had been caused during the previous week. The County Court judge having decided that there was no accident, and that the workman had suffered nothing more than an injury which might easily arise as a consequence of his ordinary work, the Court of Appeal refused to disturb his decision. Similarly in the case of Hensey *v.* White (16 T.L.R., 64) the workman was suffering from chronic inflammation of the stomach, which caused the blood-vessels to become congested, and the man died through the bursting of the blood vessels while at his ordinary work, though at the time of his death the work was more arduous than usual. The County Court judge found, as a fact, that the man died of inherent weakness of the blood vessels, and not from an accident, and the Court of Appeal supported his judgment.

In fact, the true rule whereby the word accident is to be construed was stated by Lord Halsbury in the case of Pandorf *v.* Hamilton (12 A.C. 518), where he said "the word accident involves the idea of something fortuitous and unexpected."

SMOKELESS COMBUSTION OF AMERICAN SOFT COAL.

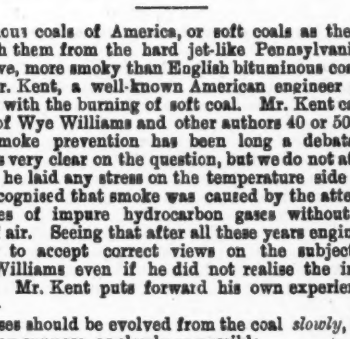
The bituminous coals of America, or soft coals as they are termed to distinguish them from the hard jet-like Pennsylvania anthracite are, we believe, more smoky than English bituminous coals. A recent paper by Mr. Kent, a well-known American engineer and a boiler expert, deals with the burning of soft coal. Mr. Kent calls attention to the work of Wye Williams and other authors 40 or 50 years ago to show that smoke prevention has been long a debatable subject. Williams was very clear on the question, but we do not at the moment remember if he laid any stress on the temperature side of the question. He recognised that smoke was caused by the attempt to burn large volumes of impure hydrocarbon gases without a sufficient admixture of air. Seeing that after all these years engineers are only now coming to accept correct views on the subject, we cannot blame Wye Williams even if he did not realise the importance of temperature. Mr. Kent puts forward his own experienced opinion as follows:—

(1) The gases should be evolved from the coal *slowly*, by which he means, we may suppose, as slowly as possible.

(2) They should be mixed with very hot air.

(3) They should be burned in a hot firebrick chamber, and

(4) While burning they should not come in contact with cool surfaces, such as the water-cooled parts of steam boilers, which means, they must have time and space in which to burn before touching the boiler. Mr. Kent says that the first condition is secured by mechanical stokers. It certainly is not secured by hand stoking, but in spite of this, we fully believe condition (1) need not be insisted upon too



strenuously where conditions (3) and (4) are provided for. The second condition he considers usually falls short in the amount of air provided and in the temperature. The third and fourth are violated in all furnaces where the coal bed is directly under the boiler, and the ordinary water-tube boiler which cools off the gases as soon as generated by means of a nest of cold water pipes is instanced. The same boiler is shown with an external furnace of firebrick extended in front of the boiler with ordinary grates and a roof and sides of brick, a bridge wall, and beyond this ordinary bridge wall a pair of walls projecting from the sides towards the middle of the furnace, so as to give a vertical central space at which the gases evolved from one side of the furnace meet with those evolved from the other side, alternate side hand firing being supposed. Beyond these walls is the combustion chamber with several projecting ribs of brick to afford a maximum of brick surface for collecting and distributing heat.

Apart from the absence from the drawing of any mechanical stoking appliance, Mr. Kent's arrangement of furnace differs little from those recently described. We should expect that with this furnace the water-tube boiler could be smokelessly hand fired. Indeed, as we have frequently pointed out, the conditions are so critical in ordinary practice that a step in the right direction, if only a short distance, will often avail to secure smokelessness. Too much stress, in the meantime, can hardly be laid on the wastefulness of excessive air. The minimum, consistent with perfect combustion, should be aimed at.

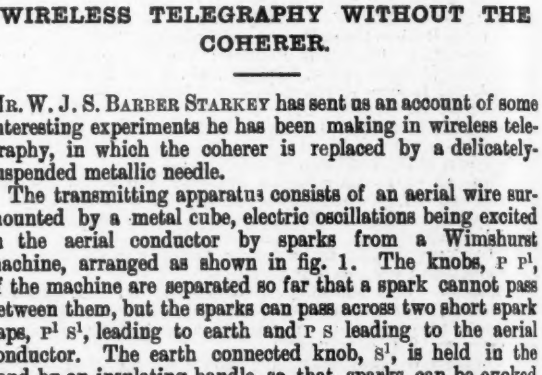
It will often be found extremely inconvenient to erect extensions of firebrick in front of a boiler. Too frequently there is absolutely no room, space being already restricted by parsimonious building construction below that required for convenient stoking. Where there is room, the application of the system to the Lancashire boiler will present some difficulty. We think, however, that a length of 2 or 3 feet of tube might be inserted in the present furnaces, the outer projecting end being supported by a stool or post from the floor. Such tube extensions might easily be made at least 6 inches wider than the furnaces, if not usually 8 inches, for they need not be absolutely concentric with the furnaces. They would thus bear the reduction of their diameter due to a lining of firebrick without being reduced as regards their grate width. We think it extremely probable that such short additions would prove quite sufficient to overcome all smoke, and to do it with actual economy. We would carry the lining forward into the boiler tubes themselves, if necessary, or even employ a number of distinct and separate narrow rings of firebrick in the tubes to diminish the exposed area of water-cooled plate.

WIRELESS TELEGRAPHY WITHOUT THE COHERER.

Mr. W. J. S. Barber Starkey has sent us an account of some interesting experiments he has been making in wireless telegraphy, in which the coherer is replaced by a delicately-suspended metallic needle.

The transmitting apparatus consists of an aerial wire surmounted by a metal cube, electric oscillations being excited in the aerial conductor by sparks from a Wimshurst machine, arranged as shown in fig. 1. The knobs, P P^1, of the machine are separated so far that a spark cannot pass between them, but the sparks can pass across two short spark gaps, P^1 S^1, leading to earth and P S leading to the aerial conductor. The earth connected knob, S^1, is held in the hand by an insulating handle, so that sparks can be evoked when required by bringing S^1 sufficiently near to P^1.

The receiving apparatus, fig, 2, consists of a delicately-suspended needle, A A, preferably made of silverfoil, and the pivot on which it is suspended is connected to earth. Near one end of the needle is mounted a second aerial conductor, R, with a cube on the top similar to the transmitting



conductor. This conductor is mounted on an insulating stand. The end of the needle is adjusted so that it is quite close to the conductor, R, but is not in contact with it.

When sparks pass at the transmitter the end of the needle, A A, is strongly attracted by the conductor, R. This movement of the needle can be utilised to ring an electric bell. A metal stop forming one terminal of the electric bell circuit is fixed on the baseboard, D, so that the needle strikes it as it approaches the conductor, R, the other terminal of the bell circuit being connected to the pivot of the needle.

Mr. Barber Starkey has succeeded with this apparatus in ringing an electric bell at a distance of 36 feet. At that distance the effect was strong, and promised to be available at much greater distances which, however, have not yet been tried.

The movement of the needle A A, is not due to an electrostatic field as in the well-known experiments of Henry, for no movement is observed till the sparks pass at the transmitter. The considerable distance at which the metallic needle is influenced also points to the action being due to

electric waves. The interesting point about the experiment is that the electrostatic attraction on the needle caused by the electric surgings in the aerial conductor should be sufficient to close an electric bell circuit. This new electric wave detector is not likely ever to be so sensitive as the coherer, but its range might no doubt be considerably increased by improvements in details.

The height of the aerial conductors employed was about 8 feet. Two small Leyden jars were used with the Wimshurst machine.

In another form of his apparatus, Mr. Barber Starkey suspends the silver needle by a fine wire from an insulating stand, and connects the attracting conductor to earth.

THE USE OF A TRADE NAME.

The recent case of The Valentine Meat Juice Company *v.* The Valentine Extract Company, in which judgment was delivered by Mr. Justice Stirling on the 14th of November, raises an interesting and important question relating to the right to use a particular name in connection with a business. The plaintiffs, who are the proprietors of an extract of meat which is sold in the liquid form, and chiefly used as a medicine, sought an injunction to restrain the defendants from carrying on any business of a similar nature in such a manner and under such a title as would lead the public to believe that the defendants' goods were those of the plaintiffs'. It was proved that in 1895 an American, named C. T. Valentine, had commenced to manufacture a meat extract in this country, and that in 1895 he had taken out a patent for a method of enclosing the extract in globules, which subsequently became known as Valentine's Meat Globules. In 1898, he transferred all his rights and interests to the defendant company, who sold the goods under the name of "Valentine's Valtine Meat Globules." It was also shown that the plaintiffs' goods had become known and identified by the use of the word Valentine in connection therewith. Mr. Justice Stirling refused the injunction for several reasons—(1) because the defendants' predecessor, C. T. Valentine, had a right to use his own name in connection with the article sold and manufactured by him; (2) because he had a right to transfer his interest therein to the defendant company; and (3) because the substance manufactured by the defendants was a *solid*, and therefore easily distinguishable from that sold by the plaintiffs.

Such are the short facts of a case which involved the consideration of a great mass of evidence and a very lengthy discussion in Court. Generally speaking, it may be laid down that a man has a perfect right to use his own name in a business, provided he does not do so with a sinister motive. "If a man uses his own name to denote his own goods, it would be intolerable to confer on him the right to prevent other people of the same name from honestly using their own name to denote their own goods, even although they might be of the same kind as his and be undistinguishable from them" (Powell *v.* Birmingham Vinegar Brewery (1896) 2 Ch., 69). Such being the general principle, it is interesting to see how far it is applicable in practice. For this purpose reference may be made to the famous case of Turton *v.* Turton (42 Ch. D., 121), which arose in Sheffield. There the plaintiffs, Messrs. Thomas Turton & Sons, sought to restrain the defendants, Messrs. John Turton & Sons, from carrying on the business of ironfounders under any title closely resembling that of the plaintiffs' firm. Much evidence was forthcoming to show that great confusion was caused in Sheffield by the similarity in title, but it was proved that the defendants, who until 1888 had been known as Thomas Turton & Co., had added the words *& Sons* solely because two sons had, in fact, joined their father in the business. The Court refused to grant the injunction.

Where, however, there is an obvious intention on the part of a trader to adopt a title closely resembling that of his rivals, he may be restrained from using it. Thus in the case of Day *v.* Day, the defendants brought a partner named Day into their firm, for the express purpose of obtaining a surreptitious introduction to the "blacking" trade with which the well-known names of Day & Martin are so widely connected. Upon application made by the firm of Day & Martin an injunction was obtained restraining the defendants from using the name Day for any such purpose. A similar application was made by the proprietors of Holloway's Pills. Of course, there are a number of cases which run very near the line, but before the Court will declare that a man must not use his own name for the purposes of his business, a clear case of fraud must be made out. In illustration of this, we might refer to the case of Jameson *v.* Jameson [15 R.P.C., 169]. There the defendant had simply placed his own Christian name and surname on his goods, which were of the same kind, and got up in the same way as the plaintiff's, that particular get-up being common to the trade. This was held by the Court of Appeal (in the absence of *mala fides*) to be quite lawful.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

24,085. "Improvements in terminals and connections for electric cables and like conductors." R. F. Hall. Dated December 4th. (Complete.)

24,095. "An improved lamp chimney for either oil lamps, gas or electric lights." T. D. Curtis. Dated December 4th.

24,116. "Improvements in electric accumulators." A. Perrin. Dated December 4th.

24,148. "Improvements in electric furnaces for making glass or other analogous substances." J. Luhne. Dated December 4th. (Complete.)

24,155. "Improvements in regulating the light of electric incandescent lamps." R. Alexander. (A. B. Vanes, Cape Colony.) Dated December 5th.

24,172. "An improved form of mercury voltameter or electric meter." M. C. Clutterbuck. Dated December 5th.

24,175. "Improvements in or relating to electrically-propelled motor cars." F. W. Dickinson. Dated December 5th.

24,184. "Improvements in or relating to electrically-propelled vehicles." F. J. Newman and J. Ledwinka. Dated December 5th. (Complete.)

24,186. "Improvements in multiple blade starting switches." W. Fairweather. (Crocker-Wheeler Company, United States.) Dated December 5th. (Complete.)

24,196. "Improvements in and relating to thermostatic electric switches or pushes." G. Harrison, of the firm of D. Young & Co. (The Auto-Protective Appliance Company, of West Virginia, United States.) Dated December 5th. (Complete.)

24,208. "Improvements in electrically-controlled locking mechanism for collecting and other boxes." H. H. Lake. (F. Williams, United States.) Dated December 5th. (Complete.)

24,288. "Improvements in conductors for electrical railways." S. E. Gunyon. (H. Privat, Germany.) Dated December 5th. (Complete.)

24,230. "An improved anode or other electrode for use in electrolysis and process of making same." J. L. Roberts. Dated December 5th. (Complete.)

24,231. "A new or improved electrical massage, rubbing, or brushing apparatus." B. Kellerman and B. Kellerman. Dated December 5th.

24,244. "Improvements in electric arc lamps." E. H. Belden. Dated December 5th. (Complete.)

24,269. "Improvements in and relating to electric incandescent lampholders." A. Marr. Dated December 6th.

24,273. "Improvements in methods of quickly establishing connection, transmitting electrical energy and telephonic messages between ships, or ships and land, also on land." J. E. Farrow. Dated December 6th.

24,297. "Improvements in accumulators." J. B. Rolin and C. A. Rosier. Dated December 6th.

24,300. "Improved means for surfacing commutators of dynamos, electric motors, and the like." T. H. Nash. Dated December 6th.

24,308. "Incandescent electric cooking and warming apparatus." L. Meunier and I. Gousset. Dated December 6th.

24,325. "Improvements in electric arc lamps." J. A. Fleming. Dated December 6th.

24,359. "Improved system of electric wiring." G. H. Chard. Dated December 7th.

24,370. "Improvements in electric switches." D. G. F. White and J. Shaw Dated December 7th.

24,387. "Electric lamp." C. V. Deventer. Dated December 7th.

24,412. "An improved tension device for coiling wire over the conductors of an armature or for operations of a similar character in which wire is paid out for coiling in a state of tension." J. W. Goundry. Dated December 8th.

24,431. "Electric rate indicators." J. Harris. Dated December 8th. (Complete.)

24,438. "Improvements in coin-controlled electric meters." The British Thomson-Houston Company, Limited. (C. E. Holmes, United States.) Dated December 8th. (Complete.)

24,439. "Improvements in systems of electric distribution, particularly applicable to electric railway systems." The British Thomson-Houston Company, Limited. (The General Electric Company, United States.) Dated December 8th.

24,440. "Improvements in or applicable to searchlight, heliograph and wireless telegraph apparatus." M. H. L. Clark. Dated December 8th.

24,450. "Improvements in electric telegraph apparatus." J. A. L. Dearlove and S. G. Brown. Dated December 8th.

24,451. "Improvements in storage batteries." H. H. Lake. (C. Bruno, Italy.) Dated December 8th.

24,458. "Improvements in supporting electrical contact rubbers or brushes below rail or tramway vehicles." R. B. Ransford. (La Compagnie Générale de Traction, France.) Dated December 8th. (Complete.)

24,473. "Improvements in accumulator plates." W. Majert. Dated December 8th. (Complete.)

24,514. "Improvements in or relating to electricity meters." A. J. Boult. (F. Saldaná, France.) Dated December 9th. (Complete.)

24,524. "Improvements in or connected with electric accumulators." G. Leve and The Monobloc Accumulator Syndicate, Limited. Dated December 9th.

24,536. "Improvements in thermo-electric piles." L. Gottscho. Dated December 9th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

43. "Improvements in electric motors and apparatus for propelling cars, carriages, cycles and boats." H. F. Joel. Dated January 1st, 1897. Electric motors and apparatus connected therewith for propelling cars, carriages, cycles, ships and boats, or for like purposes. The motor is constructed with internal fields fixed to the axle and an external armature. The field magnet is built up of two halves, which, when put together, form a central core for receiving a single coil and four radial polar extensions, the ends of which are bent over at right angles. The armature is built up of laminated iron rings or segmental plates suitably wound with coils, and carries a pulley from which the motion is transmitted by a belt to a larger pulley supported by a fixed arm. By means of a lever, the belt covered pulley can be pressed against the inner face of a projecting rim on the carriage wheel, so as to drive the latter. Instead of the lever a screw or other means may be employed for throwing the parts into gear. A somewhat modified arrangement of the apparatus for driving a carriage is also described. The motor is mounted on the rear axle of the carriage, and, by means of spur gearing, drives a countershaft supported by two pivoted levers and carrying a pair of pulleys, which, by means of belts, drive a second pair of pulleys capable of being brought into contact with the projecting rims on the wheels. The apparatus is so arranged that the action of throwing the driving pulley into gear removes the brake from the wheel. 3 claims.

850. "Process for the extraction of metallic alloys and pure metals by electric heat." H. Aschermann. Dated January 12th, 1897. In obtaining metals or alloys from their oxides in electric furnaces an easily fusible sulphide is added as a flux to prevent the formation of carbides. Sulphide of antimony is usually preferred, the antimony being afterwards removed by heating. Ferro-chromium, ferro-cerium, and alloys of iron and copper may be obtained in this way. Pure chromium and pure aluminium may also be obtained. 1 claim.

1,168. "Improvements in dynamo-electric generators and motors." E. K. Scott and A. G. New. Dated January 15th, 1897. An electric generator, motor, or motor-converter is constructed with a vertical shaft carrying an armature whose centre is arranged a little below the centre of the magnetic field, so that the upward pull relieves the downward pressure on the roller bearings. The field magnet cores are laminated in planes at right angles to the laminations of the armature; they are bent into form and secured to the frame by a bent piece and bolts. 2 claims.

1,648. "Improvements in electric switches, and in apparatus for connecting electric circuits." J. D. F. Andrews. Dated January 21st, 1897. Switches are provided with spring catches, bolts, or the like, for locking or holding the sliding contacts in their extreme positions. Switches are also combined for regulating dynamos and accumulators. The block carrying contact slides on a tube. A handle has a tubular extension sliding in which is fitted with a cross head adapted to engage the block. A catch or pawl is pivoted within the tube, and when the tube is depressed forces one end of the catch through a slot in the tube so holding the block down. On pulling the handle upwards the cross head engages the inner end of the catch and releases the block. A spring gives a quick break. A stem carries levers fitted with a spring. When the handle is forced down the spring is extended, but on lifting the handle the spring gives a quick break. Instead of levers oscillating springs may be used. In a modification a handle is fitted with a cam-like extension. In a further modification, the handle is formed of a flat metal spring with one part bent at right angles and working in a slot in a fixed stem. In other arrangements, the handle screws on a threaded stem or worm fitted with suitable guide pins. A bar is connected to the dynamo. The contacts are in connection with the cells, and the brush connects them with the bar. A cut-out in which the fuse is bent and connected to bent conductors being a suitable ring or block is described. This arrangement tends to blow out any arc that may be formed. 6 claims.

2,105. "Improvements in electric meters." The British Thomson-Houston Company, Limited. (W. C. Fish.) Dated January 26th, 1897. Relates to energy meters for continuous or alternating currents, in which an armature in a high resistance shunt circuit rotates in a field produced chiefly by coils through which the main current passes, and partly by coils in the shunt circuit, the latter being provided to overcome the friction of the moving parts; the armature drives registering mechanism by a worm. In order to stop movement of the armature due to the shunt field coils when no main current is passing, the shunt coils are short-circuited periodically during the running of the meter, by contact pieces on the first registering wheel moving between brushes. Some resistance may be placed in this circuit. The invention is applicable to meters for alternating currents, in which the armature and shunt field coils are supplied by a step-down transformer connected across the mains. 6 claims.

2,106. "Improvements in closed conduit electric railways." The British Thomson-Houston Company, Limited. (E. W. Rice.) Dated January 26th, 1897. Relates to the road contact or sectional conductor system with electro-magnetic switches. To prevent the switches being energised when not covered by the vehicle, an independent shunt circuit to the ground is provided to prevent leakage currents passing to the contact connected to the switch magnet coils. 3 claims.

2,107. "Improvements in and connected with brake shoes for electric braking apparatus." The British Thomson-Houston Company, Limited. (F. E. Case.) Dated January 26th, 1897. Relates to disc electro-magnet brakes. The shoes are mounted on the axles and are prevented from rotating by the bar which slides between the lugs and is retained in place by the plates, play being absorbed by springs. 3 claims.

2,125. "New or improved means for economising electric energy in the heating of electrically-heated apparatus and facilitating the use of such apparatus." H. Edmunds. Dated January 26th, 1897. In order to save energy, electrically-heated apparatus is enclosed with a thermostat in an asbestos or other non-conducting covering, and the thermostat is connected with a switch to cut-off or supply current as the temperature increases or diminishes. Refers to specification No. 17,643, A.D. 1892. 2 claims.

4,212. "Improvements in or connected with alternating current meters." C. Raab. Dated February 16th, 1897. A motor disc meter is provided with two shunt field coils, arranged with opposite polarities, one in circuit with a choking coil, the other with a non-inductive resistance. These co-operate with series field coils to produce the same motive power for any particular load, whether it is inductive or non-inductive, the highly inductive shunt acting in the latter case, and the non-inductive shunt when the load in the main circuit is inductive. In a modification, the choking coil in one shunt circuit is the primary coil of a transformer, the secondary of which supplies the second coil. In another, the shunt coils are placed together and act on a single disc. In another, the shunt coils are placed apart, and symmetrically as regards the field coil, on a nearly closed magnetic circuit of iron. 6 claims.

4,242. "Improvements in means for connecting or continuing electric circuits through electrollers, brackets for electric lamps, and the like." J. B. Clarke. Dated February 17th, 1897. A back plate fixed on the ceiling, &c., is formed with a central screwed socket, and carries a porcelain or other insulating flanged ring on which are placed metal blocks, with binding screws. The conductors are passed through the ring and secured permanently to these blocks. The wires in the tube of the fitting are passed out through slots, and a screw coupling is then screwed on the end of the tube. An insulating flanged ring surrounding the lower end of the screw coupling carries blocks, to which the wires are permanently attached. The fitting thus wired is fixed by screwing the coupling into the fixed socket, a washer being interposed of such thickness that the blocks come together. Electric connection is made by fuses connecting the blocks. 3 claims.

4,994. "Improvements in or relating to portable electric lamps." A. J. Boult. (H. C. Hubbell and T. F. Boland.) Dated February 24th, 1897. A casing which may be partitioned into cells is moulded from a hot mixture of asphaltum, nine parts; asbestos, one-half part; sulphur and vulcanised rubber, one-fourth part of each, in a sub-divided state. A handle or clamp, a screw-socket and central contact for the lamp and wires connecting these with pins to support the electrodes, are all embedded in moulding the casing, which may be painted. A leather strap may be attached to its sides. The lamp is enclosed by a reflector, lens, and hood. The electrodes may be lead peroxide and lead or zinc; each is made with a tapered hole, closed at the top, to fit on one of the pins, which may be split at their ends. The casing being circular and the electrodes of different sizes, they cannot be placed wrongly on the pins. A solution of acid sulphate of soda is used. The casing is closed by a soft rubber sheet, a plate, and a cover which may be screwed in, or fixed by screws. Central openings are made in the parts and a rubber diaphragm is secured by a cap in an opening in the plate; pin holes or slits in the diaphragm permit gas to escape under pressure, but confine the liquid. The lamp may be used in mines, mills, and oil works, or on bicycles or other vehicles. 10 claims.

5,040. "A new or improved telegraph relay, suitable for long submarine cables." J. Rymer-Jones. Dated February 24th, 1897. Relays for submarine telegraphy are arranged with two coils suspended in strong magnetic fields, and provided with light cross bars. The cross bars are connected by fibres and by a glass or quartz fibre. Instead of the fibre being directly connected to the bars, magnifying arrangements may be inserted. The contact lever is supported at one end by a fibre, and at the other end is provided with a T-head which plays between removable amalgamated contact plates. The suspended end of the lever is bent down and dipped in acidulated water. The lever is moved by resting on the glass, &c., fibre, and is provided with an adjustable rider. The contact plates are mounted on hinged and adjustable supports. 7 claims.

5,171. "Improvements in conductors for electric railways and the like." W. Wood. Dated February 26th, 1897. At the junction and crossings of conductors grooves are made on the underside of the connecting pieces to receive and guide the flanges of the trolley wheels as they pass. 3 claims.

5,224. "Improvements in electric arc lamps." R. Raynor. Dated February 26th, 1897. The lower carbon is supported in the bend of a U-shaped tube or grooved bar, the vertical limbs of which slide in insulating rings in larger tubes fixed on the lamp frame. The U tube is supported by a flexible cord or chain passed through it and over a guide or guides to a pulley on a brake wheel. One end of the cord may be attached to the frame, or both ends may be attached to the pulley. When one end is fixed, the friction of the cord in the tube checks sudden movements of the carbon. The upper carbon may be supported by another U tube, or a weighted head connected by a rack and pinion, or by a cord with another pulley on the brake wheel. The brake wheel is carried by a screw threaded axle, or its rim is threaded, so that when rotating it moves laterally into contact with inclined brake surfaces on the regulating lever. The edge of the wheel is bevelled correspondingly, and the pulley surfaces are coned in order to increase their working diameter as the carbons are consumed and render their operations uniform. To strike the arc, the axle is carried by a tube vertically movable by connection with the core of a series solenoid, to lower the brake wheel and thus operate the cords to separate the carbons. The core is provided with rings so that the solenoid serves as a dash pot. In a modification, the spring and arm are dispensed with, the series coil core being attached to the regulating lever, so that this depresses the brake wheel to strike an arc. 9 claims.

5,237. "Improvements in the suspension of electrical accumulators or batteries on motor carriages." Hon. R. T. D. Brougham and W. C. Bersey. Dated February 26th, 1897. Consists of means for resiliently suspending accumulators or batteries on motor carriages in such a manner as to prevent undue oscillation and shocks. The box containing the batteries is suspended from the frame of the vehicle by links, supported by springs. Oscillation is checked by the bar pivoted at one end to the box and at the other end to the frame. The dies of continuous wire drawing machines are arranged in their supports out of line with one another, so that the wire passes round the drawing through rollers or cylinders in spiral lines. The rollers which rotate in troughs may be mounted eccentrically on their shafts, or their bosses may be bored out larger than the shafts to give freedom to the motion of the wire and prevent it cutting into the rollers. The periphery of the cylinders or rollers may be concave. 2 claims.

5,258. "Improvements in electrically propelled motor road vehicles." L. Epstein. Dated February 26th, 1897. This is a vehicle of the kind described in Specification No. 15,564, A.D. 1895. On the fly-wheel shaft of the motor engine is secured a toothed wheel, which when the wheel is made to gear with it communicates motion from the engine to the dynamo-electric machine, the electricity produced being stored in accumulators at the back or back and front of the vehicle. Electricity is only produced when the vehicle is at rest, and issued to work as an electromotor, when the wheel is put out of gear with the wheel, and the wheel made to gear with the wheel; motion being then communicated from the electromotor to the countershaft and thence from the pinions by chains to the sprocket wheels on the axle of the driving wheels. The brake on the drum is controlled by a treadle. The front wheels have their axles pivoted on the ends of a cross bar, and by moving the handle both wheels are turned, thus steering the vehicle. 1 claim.

5,360. "A method of and apparatus for utilising electric energy." H. S. Cox. Dated February 27th, 1897. Contact is made and broken at the make and break switch, the lamps being alternately in and out of the battery circuit. It is stated that a much higher potential is obtained in the circuit and increased brightness of the lamps. Instead of the magnetic make and break a rotary one may be employed. 6 claims.

5,383. "Improvements in primary galvanic batteries." S. F. Walker. Dated March 1st, 1897. In portable, single fluid carbon zinc cells, the electrolyte consists of a solution of chromic acid with hydrochloric acid and sodium sulphate. To purify the acids, impurities may be precipitated by the use of suitable salts, such as barium chloride. The carbon is in the form of a hollow perforated cylinder, and the zinc is cast in the form of an inverted cone about a central supporting wire of iron or brass. The pores of the carbon are filled with sulphate in the manner described in Specification No. 12,028, A.D. 1897. 7 claims.

5,430. "Improvements in speed-regulating governors, specially suitable for electric light and other high speed engines." J. T. Marshall. Dated March 1st, 1897. Consists in a form of governor especially suitable for electric light or other high speed engines. A sleeve is mounted on a rotatory spindle so as to be capable of sliding thereon while revolving. The upper end of this sleeve carries a plate, on which are hung the centrifugal weights. The tails of these bear, through anti-friction rollers, on a plate rigidly attached to the end of the spindle. Outward movement of the weights raises this plate against the resistance of the springs, which are held between a collar on the sleeve and an adjustable abutment plate bearing, through studs, against the plate. The spring is preferably made in two parts oppositely coiled, so that the twist taking place on compression or extension shall be neutralised. 5 claims.

6,178. "An improved device for deadening the noise in telephone conductors and the like." H. Messing. Dated March 9th, 1897. A hollow sleeve of India-rubber or similar substance is enclosed in a split sleeve of lead. The ends of the sleeve are solid except for radial slits corresponding in position to the opening on the lead sleeve, so that the whole can be slipped on to a telephone, &c., line so as to deaden the buzzing in the wires, rods or posts. 1 claim.